Vol. 23 DECEMBER • 1960 No. 4

LLOYDIA

A Quarterly Journal of Biological Science

Published by the Lloyd Library and Museum, Cincinnati, Ohio

Studies on the Anthracnose Fungus of Hibiscus Cannabinus L.

ARATI SARKAR[1]

(*State Agricultural Research Institute, Calcutta, West Bengal, India*)

Anthracnose of *Hibiscus cannabinus* L., attributed to *Colletotrichum hibisci* Poll., was first reported from Java by Hartley (1). Since then the disease has been reported from almost all regions where the crop is cultivated. In spite of the repeated appearance of the disease, knowledge regarding the pathogen is still meager. Prestley (2) reported a brief history of the disease, while the parasitic mechanism of the organism was studied by Venning and Crandall (3). Summers and Pate (4) carried on susceptibility tests at different temperatures. A thorough search of the literature failed to reveal further published work on the biology of the organism.

MATERIALS AND METHODS

Isolations were made from infected stems of *Hibiscus cannabinus* L., and as these appeared identical in each case, a typical one was chosen and cultured from a single spore. The isolate was maintained on potato dextrose agar slants at 20° C. and its pathogenicity was confirmed by reinfection of the host. Measurements of reproductive structures were made with 10-day old cultures grown on potato dextrose agar medium.

MORPHOLOGY OF THE FUNGUS

The fungus on potato dextrose agar shows submerged growth and is dark ashy gray in color. Aerial mycelium was infrequent and light gray in color. Acervuli were scattered irregularly over the surface of the medium and setae were present. They are dark brown, stiff and long with pointed ends, measuring 106.4–239.4 μ x 5.4–6.6 μ. Conidia are unicellular, hyaline and slightly curved with acute ends, measuring 20.5–24.6 μ in length and show no appreciable variation in breadth. The average size of a conidium is 23.2 μ x 6.0 μ.

CULTURE CHARACTERISTICS AND RESULTS

Cultural studies were carried out in 10 cm petri dishes containing

[1]Present address: Department of Microbiology, Bose Institute, 93/1, Upper Circular Road, Calcutta-9, India.

20 ml of the medium in each case. Inoculations were made at the center with 2 mm mycelial disc of a 7-day old culture maintained on potato dextrose agar slants and incubated at 30° or 32° C. The colony diameter was measured along two directions at right angles to each other.

Growth in different media.—The fungus was grown on a number of media, viz., potato dextrose agar, oat meal agar, Richard's agar, Czapek Dox agar, Brown's agar and glucose peptone agar. In each case petri dishes were established in three replications. Cultural characters, observed after 7 days of incubation at 30° C. are recorded in table 1.

TABLE 1.—*Growth characters of C. hibisci in different media at 30° C.*

Media	Colony Diameter, mm		Sporulation[2]	Growth Characters
	Range	Average		
Potato dextrose agar	50–65	59	++	Submerged mycelium
Oat meal agar	42–50	45	+++	Submerged mycelium
Richard's agar	78–90	83	++	Growth of both submerged and aerial mycelium
Czapek Dox agar	49–61	55	++	Growth of submerged mycelium
Brown's agar	70–82	75	—	Thin growth of submerged mycelium
Glucose peptone agar[1]	60–70	64	++++	Submerged growth

[1]Glucose peptone agar medium, g per liter: glucose, 5.0; peptone, 5.0; KH_2PO_4, 0.75; $MgSO_4 \cdot 7H_2O$, 0.75; agar, 20.0.
[2]Symbols denote comparative amount.

Saltations often appeared in Richard's agar medium in narrow triangular shapes with the apex pointing towards the center of the petri dish. The saltant mycelium was sterile and light gray in color, differing from the dark gray parent mycelium.

Growth at different temperatures.—Growth and sporulation of the fungus were studied on glucose peptone agar medium. Petri dishes were incubated at different temperatures and data obtained after 7 days is presented in table 2.

Growth with different carbon sources and in different concentrations of dextrose.—The fungus was grown in petri dishes in basal medium composed of the following; g per liter: KNO_3, 10.0; KH_2PO_4, 5.0; $MgSO_4 \cdot 7H_2O$, 2.5; dextrose, 40.0; and agar, 20.0, in which dextrose was replaced by equivalent amounts of other carbohydrates. Observations noted after 7 days of incubation at 30°C. are presented in table 3.

The fungus was grown in petri dishes containing the basal medium in which dextrose was added in concentrations of 2.5, 5.0, 10.0 and 15.0 percent. Results obtained after 7 days of incubation at 32° C. are presented in table 4.

Growth with different nitrogen sources and in different concentrations of potassium nitrate.—The fungus was grown in petri dishes in the basal medium in which potassium nitrate was replaced by equivalent quantities of various nitrogen compounds. Observations made after 7 days of incubation at 30° C. are given in table 5.

TABLE 2.—*Growth and sporulation characteristics of C. hibisci at various temperatures.*

Temperature (°C.)	Colony Diameter, mm Average	Intensity of Sporulation
8	10	—
15	25	+
20	35	++
25	60	+++
29	64	++++
32	66	+++
37	25	++

TABLE 3.—*Growth of C. hibisci in culture media containing various carbohydrates, at 30° C.*

Carbohydrates	Colony Diameter, mm		Sporulation	Growth Characters
	Range	Average		
Dextrose	70–88	76	++++	Extensive growth
Sucrose	70–90	76	++++	Extensive growth
Maltose	70–91	78	+++	Good growth
Fructose	68–80	75	+++	Good growth
Starch	40–60	53	++	Good growth
Xylose	59–70	64	++	Good growth
Cellulose	41–50	45	—	Poor growth of submerged mycelium
Lactose	45–62	53	—	Poor growth of submerged mycelium

TABLE 4.—*Growth of C. hibisci in basal medium containing different glucose concentrations at 32° C.*

Dextrose Concentration, Per Cent	Colony Diameter, mm		Intensity of Sporulation	Nature of Growth
	Range	Average		
2	70–98	90	++	Growth with moderate sporulation
5	83–98	95	++++	Extensive growth with abundant sporulation
10	70–92	85	—	Growth with black stromatoids, no sporulation
15	60–80	72	—	Poor mycelial growth, no sporulation, no stromatoids

The fungus was grown in petri dishes in basal medium in which potassium nitrate was added in concentrations of 0.5, 1.0, 2.0, and 4.0 per cent. Results recorded after 7 days of incubation at 32° C. are given in table 6.

TABLE 5.—*Growth of C. hibisci in basal media containing various nitrogen compounds at 30° C.*

Nitrogen Compound	Colony Diameter, mm		Sporulation	Growth Characters
	Range	Average		
Potassium nitrate.....	70–92	77	++++	Submerged growth, aerial mycelium sparse
Sodium nitrate.	68–90	77	++++	Submerged growth, aerial mycelium sparse
Asparagine....	80–95	87	++++	Growth of both submerged and aerial mycelium
Urea.....	68–76	73	+++	Growth of submerged mycelia, aerial mycelia sparse
Ammonium nitrate.....	42–58	50	—	Moderate growth of both submerged and aerial mycelium
Ammonium Sulphate.....	24–30	26	—	Restricted mycelial growth, leathery texture
Sodium nitrate.	0	0	—	No growth

TABLE 6.—*Growth of C. hibisci in basal medium containing different concentrations of potassium nitrate at 32° C.*

Potassium nitrate Concentration,	Colony Diameter, mm		Sporulation	Nature of Growth
	Range	Average		
0.5	73–90	83	++	Good growth
1	74–90	83	++++	Good growth
2	75–90	84	+	Good growth
4	68–80	74	—	Good growth

GERMINATION TESTS

Spores from a two-week old culture were suspended in sterile distilled water, tap water, 2 per cent sucrose solution, 2 per cent dextrose solution, and 2 per cent malt extract. Dilutions were prepared to contain approximately 200 spores, within the low power field of the microscope, as a suspension placed in grooved slides. The slides were covered with cover slips and incubated in a humid atmosphere at 30° C. Five slides were prepared for each suspension. After 24 hours, only the spores in 2 per cent malt extract had germinated. Germination in other media were not observed after 48 hours. The experiment was repeated at 25° C. and the result was the same.

Grooved slides containing spore suspension in 2 per cent malt extract were incubated in 5 replications at each of 8 different tem-

peratures within the range 8°–40° C. In each culture the first 100 spores encountered under the microscope were observed to determine the number of germinated spores. Data obtained after 24 hours of incubation indicate a temperature range for spore germination between 15–37° C. with the optimum at about 32° C., with 95 per cent germination. Germination is totally inhibited at 8° and 40° C.

During the early stage of germination a spore swells and a germ tube emerges from one end or occasionally from the side. Vary rarely more than one germ tube arises from a spore. As the tube contacts the slide surface, the tip swells into a brown thick-walled appressorium. Occasionally the tube branches and each branch terminates into an appressorium upon contact with the glass surface.

SUMMARY

Colletotrichum hibisci Poll., the anthracnose organism of *Hibiscus cannabinus* L. was isolated and certain culture characteristics are reported. The spores measure 23.2 μ x 6.0 μ, and setae measure 106.4–239.4 μ x 5.4–6.6 μ.

The fungus grew well on potato dextrose agar, oat meal agar, Richard's agar, Czapek Dox agar and glucose peptone agar. Mycelial growth was most abundant on Richard's agar while sporulation was most extensive on glucose peptone agar.

Optimum temperature for the growth and spore germination was about 32° C.

Dextrose, sucrose, maltose and fructose were good carbon sources for growth and sporulation of the fungus. Starch and xylose were moderately favorable while cellulose and lactose were totally unfavorable. Best growth was observed in medium containing 5 per cent dextrose.

Best growth and sporulation with various nitrogen sources was recorded with asparagine. In potassium nitrate, sodium nitrate and urea growth and sporulation was good, while in ammonium nitrate and ammonium sulphate growth response was poor. No growth was observed in medium containing sodium nitrite. Sporulation was best in basal medium containing 1 per cent potassium nitrate.

Spores germinated in 2 per cent malt extract. Germ tubes swelled into appressoria on contact with the surface of the slide.

ACKNOWLEDGMENT

The writer wishes to express her sincere thanks to Dr. S. B. Chattopadhyay, Mycologist to the Government of West Bengal, India, for his interest and encouragement in this work.

LITERATURE CITED

1. **Hartley, C.** 1927. Notes on hibiscus diseases of West Java. Phytopathology **17:** 25–27.
2. **Prestley, J. T.** 1952. Colletotrichum tip blight of kenaf: a brief history of the disease. Plant Disease Reptr. **36:** 333–334.
3. **Venning, F. D.** and **B. S. Crandall.** 1954. Parasitic mechanism of the kenaf anthracnose organism related to the H-ion concentration in the tissue of the host. Phytopathology **44:** 465–468.
4. **Summers, T. E.** and **J. B. Pate.** 1955. Influence of temperature on the susceptibility of kenaf to *Colletotrichum hibisci* Poll. Plant Disease Reptr. **39:** 650–651.

Morphology of the Gametophyte of Quercifilix Copeland

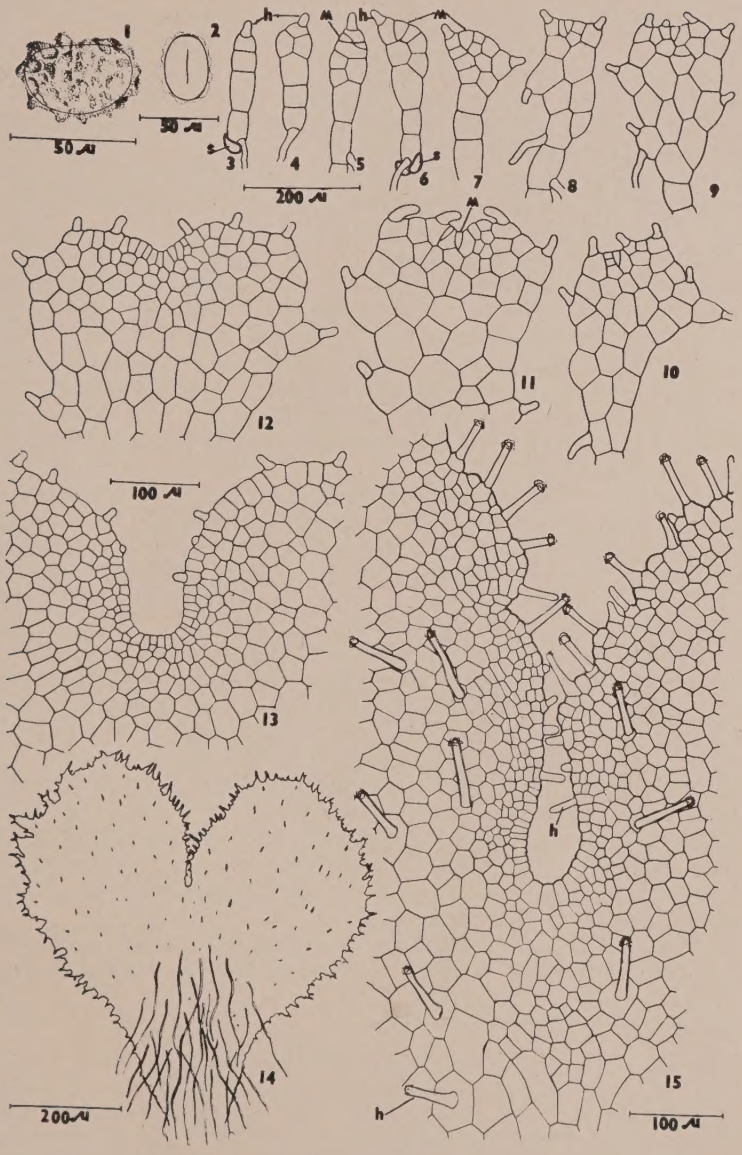
B. K. Nayar
(*National Botanic Gardens, Lucknow, India*)

Quercifilix Copeland is a much confused and little known monotypic genus of Tropical Asia, the sole species, *Q. zeylanica*[1] (Houtt.) Copel. (*Ophioglossum zeylanicum* Houtt., *Leptochilus zeylanicus* C. Chr., *Gymnopteris quercifolia* auctt.) occurring in Ceylon, Mauritius, S. China, Formosa and Borneo. It is regarded by contemporary pteridologists as an acrostichoid derivative of *Tectaria* (1–4). The present study was undertaken to assess the contribution of the gametophyte to the phylogeny of the genus. Spores for this study were obtained in October, 1959, from the Hortus Botanicus Hauienensis and were cultured immediately on Knop's agar medium and on sterilized, well-deteriorated moss beds. Methods followed are the same as described earlier (5). Observations on spore morphology were made on acetolysed preparations mounted in glycerine jelly (6).

The spores (figs. 1, 2) are monolete (bilateral), with a thin, smooth exine and a membraneous, highly wrinked perine, which in some cases may appear as irregularly reticulate ridges. Average spore dimensions are 33 x 48 x 35 μ (P x E_1 x E_2, exclusive of the perine).

The spores germinate readily in culture; the exine rupturing at the laesura and usually the rhizoid protrudes first. The germ filament soon emerges and the spore coat splits into two valves which are generally shed. The filament becomes three to five cells long, the cells being densely chlorophyllous and barrel-shaped. The basal cells usually elongate slightly and are generally narrower than the others. The terminal cell soon stops growth and terminates in a short mammillate or papillate hair (fig. 3). The penultimate cells divide longitudinally, initiating flattening of the germ filament (fig. 4). The cell below the terminal cell divides longitudinally and the daughter cells expand laterally, often protruding out of the general surface. An oblique wall formed at an angle to the basal wall of the terminal cell cuts off a wedge-shaped meristematic cell (fig. 5). This cell continues the growth of the thallus by cutting off daughter cells alternately on the oblique sides (figs. 6, 7). Rarely, the penultimate cell of the germ filament cuts off two wedge-shaped cells, one on either side of the terminal cell. Usually, in such cases, only one of them becomes meristematic, but rarely both may continue growth for a short time and later on one of them terminates in a hair. Soon after a definite meristematic cell is established, flattening of the thallus proceeds rapidly by the active divisions of the nearby cells. Only the anterior cells of the germ filament take part in the flattening. The thallus becomes nearly triangular with an almost flattened apex (figs. 8, 9). Papillate hairs are formed profusely by the marginal cells. The apical meristematic cell may often stop growth and become a hair. In such cases

[1]Spelled '*Q. zeilanica*' by Copeland (1947).



FIGS. 1–15. Morphology of spore and young prothallus (*m*, meristematic cell; *h*, hair; *s*, spore coat). FIG. 1. Lateral view of the spore. FIG. 2. Proximal view of the same. FIG. 3. Germ filament in which the terminal cell ends in a hair. FIG. 4. Flattening of the germ filament by division of the anterior cells. FIG. 5. Germ filament showing formation of a meristematic cell lateral to the terminal hair. FIGS. 6–11. Stages in the development of the flattened apex of the young prothallus. FIG. 12. Apex of young prothallus in which the apical meristematic cell is replaced by a multicellular meristem. FIG. 13. Apex of prothallus showing formation of an apical notch. FIG. 14. Young cordate prothallus. FIG. 15. Apex of the same showing details.

another meristematic cell is soon established lateral to the hair. Due to repetition of this process, young thalli at this stage of development are often irregular in shape (fig. 10). The prothallus later becomes spatulate, with the margin often irregular because of the hairs but chiefly because the cells bearing the hairs often protrude prominently forming conical protruberances (fig. 11).

The apical meristematic cell may persist until the apex of the thallus becomes notched. It is soon replaced by an apical meristem of usually two or three actively dividing pyramidal cells which taper slightly towards the outer periphery (fig. 12). Marginal hairs are produced profusely and in the early stages of development they are curved towards the meristem of the thallus. The hairs are formed by cells close to the meristem. As the apex of the thallus becomes distinctly cordate the margin of the thallus is more or less smooth at the apex (fig. 13). The apical meristem becomes broader, although a pair of actively dividing cells can still be distinguished. Papillate hairs, resembling marginal hairs are formed sparsely on both surfaces, on the apical portion of the thallus.

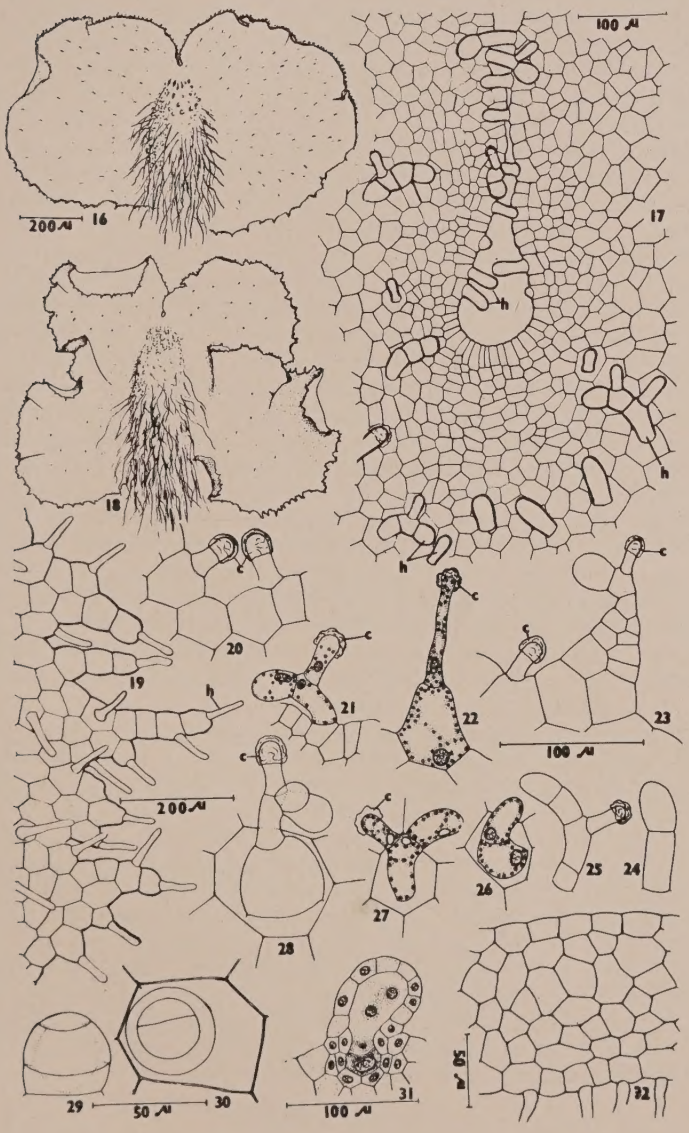
Within three months after germination the prothallus becomes distinctly cordate, with a deep narrow apical notch (fig. 14) and bears antheridia on the surface, although only one cell thick throughout. The apical meristem becomes broader and hairs are formed profusely (fig. 15). The margin becomes lacerate due to unicellular and multicellular protrusions, each bearing one or more hairs. The hairs are long, unicellular and narrow, bearing prominent extracellular greenish-yellow apical cap-like secretions with a rough exterior. These caps can be easily dissociated from the hair by gentle pressure, retaining their shape after removal. They are readily soluble in organic and inorganic acids and in chloroform, ether, xylol and acetone. The hairs are chlorophyllous (fig. 22), the chloroplastids being nearly of the same size as those of the other prothallial cells. New hairs are generally formed secondarily by cells far removed from the meristem, so that hairs at all stages of development are often found together both on the margin and on the surface. Some of the older hairs may develop a transverse septum toward the base.

Prothalli attain maturity within five months after germination. The mature prothallus is cordate, with a deeply notched apex and

---

EXPLANATION OF FIGURES

FIGS. 16–32. Morphology of mature prothallus (*c*, extracellular cap; *h*, hair). FIG. 16. Mature prothallus (ventral view). FIG. 17. Apex of the same showing details. FIG. 18. An old prothallus showing tendency to become elongated and heavy (ventral view). FIG. 19. Portion of margin of prothallus showing cellular outgrowths bearing hairs. FIG. 20. Unicellular marginal hairs. FIG. 21. Multicellular marginal hair (optical section). FIG. 22. An elongated hair borne on a conical marginal cell (optical section). FIG. 23. Multicellular hair borne on a conical marginal protuberance. FIGS. 24–27. Multicellular superficial hairs. FIG. 28. Multicellular superficial hair borne on a hemispherical protuberance of a subtending cell. FIG. 29. Mature antheridium (lateral view). FIG. 30. Same, proximal view showing a divided cap cell (the outline of the subtending cell is shown for comparison of size). FIG. 31. L.s. of mature archegonium. FIG. 32. T.s. of portion of the midrib of prothallus.


200 µ
16
100 µ
17
h
h
h
18
19
20
c
21
c
22
c
23
c
100 µ
h
200 µ
c
27
c
26
25
24
28
29
50 µ
30
100 µ
31
125 µ
32

nearly semicircular wings which may slightly overlap anterior to the meristem (fig. 16). The margin of the thallus is lacerate and often irregularly wavy. The midrib is five to eight cells thick (fig. 32) and bears rhizoids and sex organs on the lower surface. The apical meristem of the mature prothallus (fig. 17) is broad and consists of a large number of narrow pyramidal cells arranged in a regular row and often masked by the curved tips of the marginal and superficial hairs. The wing cells of the prothalli are uniformly thin-walled and densely chlorophyllous. Hairs occur densely over the surface and the margin. Some of the older prothalli become slightly elongated and develop irregularly folded wings (fig. 18). In addition to the unicellular hairs described on the young thallus, the mature thallus bears branched and unbranched multicellular club-shaped hairs which are more abundant superficially than marginally. The marginal multicellular hairs on the older regions of the thallus often become seated on tooth-like protrusions of the margin of the prothallus (fig. 23). The unbranched hairs usually possess an elongated stalk bearing a dome-shaped terminal cell (fig. 24). The branched hairs are similar to these, except that the stalk cell bears a unicellular papillate branch similar to the unicellular papillate hairs of the prothallus (figs. 21, 25, 27). These lateral branches are narrow and possess cap-like secretions. The hair is usually three or four cells in length, the cells being chlorophyllous and barrel-shaped. In some cases all the cells of the hair, except the terminal dome-shaped cell, may bear papillate capped branches. Usually these branches are solitary on each cell of the hair and are borne laterally towards the anterior end of the cell. The multicellular hairs are curved prominently towards the apex of the prothallus. In many cases the prothallial cell bearing the multicellular hair protrudes from the general surface. In some cases these protrusions become cut off as hemispherical cushions subtending the hair (fig. 28). All hairs are chlorophyllous and possess dense cytoplasmic contents.

Antheridia are formed superficially by cordate thalli, even before the formation of a midrib. Under cultural conditions no marginal antheridia were noticed and no antheridia occurred on filamentous thalli. The antheridia are sub-globular or slightly elongated (fig. 29). The basal wall of the central cell may or may not touch the basal wall of the stalk cell so that the latter is either funnel-shaped or saucer-shaped. The opercular cell is single, or rarely divided, (fig. 30) and is thrown out to release the sperm. Development of the antheridium is of the common type in the Polypodiaceae (7). Archegonia are formed only near maturity, when the midrib is established. The archegonial neck is composed of four tiers of cells and is usually four to six cells long. It is prominently curved away from the apex of the prothallus and near maturity has a swollen apex (fig. 31). The base of the neck may occasionally bear one or two unicellular papillate hairs.

DISCUSSION

Copeland (8) on establishing the genus *Quercifilix* comments that "The probable source of *Quercifilix* is in the quite distinct group represented for example, by *Tectaria labrusca*." According to Holttum (4) it is "evidently an acrostichoid derivative of *Tectaria*, probably

related to *T. macrodonta*". Ching (9) however, associates it with *Bolbitis* and other acrostichoid Aspidiaceae like *Stenosemia* and *Hemigramma*. Little, however, is known regarding the morphology of the gametophyte of the genus *Tectaria*, and for that matter, the majority of Copeland's Aspidiaceae. Kachroo (10) has described the mature prothalli of two species of *Tectaria* and for comparison the gametophytes of six species of *Tectaria* were grown in this laboratory. The present comparison is based on observations made on these cultures. The spores of *Quercifilix* are very much like those *Tectaria* in detailed morphology. The germ filament in *Tectaria* terminates in a hair and a meristematic cell is established as in *Quercifilix*. In fact the characteristic shape of the young prothallus of *Quercifilix* is identical to that of *Tectaria*. The mature gametophyte of *Tectaria* is also similar in being massive, cordate and hairy. The characteristic lacerate margin of the prothalli and the abundance of the hairs of *Quercifilix*, however, are not evident in *Tectaria*. Also, the genus *Tectaria* possesses both the types of hair, viz. the papillate, capped and the multicellular, branched, as in *Quercifilix*. The branched multicellular club-shaped hairs appear characteristic, not being reported in any other Aspidiaceae. These hairs are very sparse in *Tectaria*, seen only in some species and are restricted to the surface of the midrib. Multicellular hairs, somewhat similar to these but devoid of branches, are reported on the prothalli of *Bolbitis* (5), and similar hairs have been observed in cultures of a few species of *Egenolfia* grown in this laboratory. However, *Egenolfia* and *Bolbitis* are not comparable to *Quercifilix* in other characters of the gametophyte.

The present observations seem to confirm the view that *Quercifilix* and *Tectaria* are closely related genera and that the former is more advanced than the latter.

SUMMARY

Quercifilix is a monotypic genus, generally regarded as an acrostichoid derivative of *Tectaria*. The spores are monolete with smooth exine and thin convoluted perine. On germination the germ filament becomes 3–5 cells in length and terminates in a hair. A meristematic cell is formed laterally and the prothallus becomes spatulate at first and then cordate. Papillate hairs are produced profusely on the margin which often becomes lacerate. Superficial papillate hairs are formed as the prothallus becomes cordate. The apical meristematic cell is replaced by a meristem which becomes lodged in an apical notch. The mature prothallus is cordate and profusely hairy, the large majority of hairs being papillate and capped. Multicellular hairs bearing papillate, capped branches occur sparsely on the margin and over the surface. Sex organs are of the usual type in higher ferns.

ACKNOWLEDGEMENTS

I am deeply indebted to Professor K. N. Kaul, Director, National Botanic Gardens, Lucknow, for the interest he has shown in this work and to the authorities of the Hortus Botanicus Hauienensis for supplying the spores used in this study.

LITERATURE CITED

1. **Copeland, E. B.** 1947. Genera Filicum. Chronica Botanica Co., Waltham, Mass.
2. **Holttum, R. E.** 1947. A revised classification of the leptosporangiate ferns. J. Linn. Soc. (Bot.) **53**: 123–58.
3. ———. 1949. The classification of ferns. Biol. Rev. **24**: 267–96.
4. ———. 1954. Flora of Malaya, **2.** Ferns. Singapore.
5. **Nayar, B. K.** 1960. Morphology of two Indian species of *Bolbitis*. J. Indian Bot. Soc. **39**: 259–283.
6. **Erdtman, G.** 1952. Pollen morphology and plant taxonomy. Almqvuistand Wiksells, Uppsala.
7. **Davie, J. H.** 1951. Development of antheridium in the Polypodiaceae. Amer. J. Bot. **38**: 621–29.
8. **Copeland, E. B.** 1928. *Leptochilus* and genera confused with it. Phillip. J. Sci. **37** (4): 333–416.
9. **Ching, R. C.** 1940. On natural classification of the family Polypodiaceae. Sunyatsenia **5** (4): 201–68.
10. **Kachroo, P.** 1956. Gametophytes of *Tectaria variolosa* and *T. fuscipes*. Science and Culture **22**: 103–5.

Studies on Spirostreptoid Millipeds. V. A Synopsis of the Genus Heteropyge, with some Notes on the Status of the Names Alloporus and Plusioporus[1]

Richard L. Hoffman
(*Blacksburg, Virginia*)

In 1914, Carl Attems listed (1) somewhat over 250 specific names of spirostreptoid millipeds which had been so poorly proposed that he was unable to refer them even to a genus. Since that time, some of these species have been redescribed and placed in the classification, but so far only a start has been made in reducing this astounding backlog which is even today still being increased by the irresponsible practice of basing new specific names on female specimens. There is also a smaller, but no less vexatious, category of enigmatic generic names, many of which were erected by Filippo Silvestri during the 1890's, in a manner which in no way foreshadows the high quality of his later descriptions.

One of these mysterious genera, which has evaded elucidation for more than 60 years, and which, in fact, seems not even to have been mentioned in the literature since 1914, is Silvestri's *Heteropyge*, proposed in 1897 (2) without diagnosis and with only the designation of *Odontopyge paraguayensis* Silvestri as the type species. Sufficient evidence is now at hand to permit a reasonably confident solution of the matter.

In previous papers in this series (3–6), attempts were made to establish the correct identity of other Silvestrian names, based for the most part on the study of specimens identified by the author. This concern with solution of long standing nomenclatural enigmas has, however, been opposed in a recent paper (7) by Schubart. The resurrection of *Plusioporus*, in particular, to stand as the correct generic name for species which have been erroneously referred to the poorly known African genus *Alloporus*, has invoked Schubart's criticism. His arguments may be summarized as follows: (i) *Plusioporus* was based by Silvestri upon *P. salvadorii*, a new species originally recorded from Paraguay and Argentina. The generic diagnosis is short and noncommital. The specific description gives little of diagnostic value, aside from a rough outline sketch of the gonopods. A worker without material of this species might easily consider it as unidentifiable. Although the specimens which were described (4) as *P. salvadorii* had been labeled as "paratypi" by Silvestri, they were actually collected four years after the species was proposed, and, as Schubart observed, might easily be a different species. (ii) The revival of such a name as *Plusioporus* is undesirable in replacing an old and well-established name (*Alloporus*) for a familiar group of Brazilian species.

A rejoinder to these sentiments is not difficult to phrase. An

[1]This paper was written while the author was employed at the U. S. National Museum, under a grant from the National Science Foundation.

examination of the facts in the case follows. (i) It is indeed true that the specimens which were described as *salvadorii* may not be conspecific with the true types. On the other hand, (*a*) they agree with the specific diagnosis and especially well with the sketch of the gonopods, (*b*) they are from one of the localities originally stipulated for the species (since Silvestri did not designate a single type locality, how can Schubart say the Chaco specimens are not actually topotypes?), and (*c*) they were identified as *salvadorii* by the author of that name. It is evident that in his early work, Silvestri's draftsmanship was weak, but in view of the foregoing information, it is unreasonable to assume that his identification needs to be challenged, particularly when it is recalled that Silvestri was certainly not a "lumper."

In the event that subsequent study of the holotype (or of a lectotype, if no single holotype was designated) of this species shows otherwise, it does not seem possible that the form which was described from Chaco, in northern Argentina, can be very distantly related to the true *salvadorii*. Their congenericity can be assumed with confidence as I think will be obvious to anybody who compares Silvestri's sketch of the gonopods with the illustration which was more recently published (4).

(ii) With respect to the confusion and inconvenience resulting from the replacement of "Alloporus", I can only remark that this generic name had been used in the literature on South American spirostreptoids less than a dozen times, chiefly in connection with the description of new species, and this amount of usage scarcely seems sufficient to result in entrenchment! It is likewise important to recall that *Alloporus* was, to begin with, based on an African species (*dissimilis* Porat) known only from the female sex, and that in actuality it is not evident what the true characters of the genus may be.

Although Porat himself was the first author to describe an American spirostreptid in the genus *Alloporus*, being motivated solely by the distribution of the ozopores, this practice really gained its impetus in 1895 when Silvestri (8) used the name for a number of new species from South America. Subsequently, realizing the improbability that American and African species were congeneric, Silvestri proposed new genera for his *Alloporus* species, but the old name was retained by the conservative Brolemann in his important paper on the myriapods of the Sao Paulo Museum, and the "Alloporus Tradition" thus had its origin about 1902. Even Count Attems realized the improbability that the South American species listed under this name were closely related to *Alloporus* and proposed (9) the new subgenus *Hessonoporus* for the New World forms (an Attemsian subgenus is generally equivalent to a full genus in the usage of most other myriapodologists). Two full years later, C. A. W. Jeekel published his independently conceived opinion about the relationship of the two groups of species, and suggested revival of the name *Nesostreptus* (Attems, 1927, type, *N. novarae* Attems from "Madeira") for the Neotropical group. Schubart has adopted this proposal in part, but defeated the main purpose of the suggestion by placing *Nesostreptus* as a subgenus of *Alloporus*. His reluctance to part with the totally inapplicable name *Alloporus* is curious indeed!

In summary, most specialists interested in spirostreptoids now

agree that the American species traditionally referred to *Alloporus* are not congeneric with the African species also traditionally referred to the same, still enigmatic generic name. As long as the type species of *Alloporus* remains unknown, the status of the latter group must remain in doubt, but there is no real question that the name *can not* be used for the American species. Of the three generic names based on various of these American species, *Plusioporus* is by far the oldest, and no one can seriously dispute that *Plusioporus salvadorii*, or at any rate the material which Silvestri determined as *salvadorii* and which I redescribed under that name, is strictly congeneric with them. The rejection of a generic name merely because it is weakly diagnosed may be understandable at times, but has absolutely no precedent nor justification in taxonomic procedure, and anyone conversant with the rudiments of nomenclatural logic must agree that *Plusioporus* cannot be denied its rightful place as a valid generic name.

This somewhat lengthly preamble is introduced partly to reaffirm my position concerning the particular case of *Plusioporus*, and partly because the following resurrection of another Silvestrian genus from utter obscurity falls into almost exactly the same category.

Genus HETEROPYGE Silvestri

Odontopyge (*nec* Brandt) Silvestri, 1895. Boll. Mus. Torino **10**(203): 11 (in part, for *O. paraguayensis* Silvestri).

Heteropyge Silvestri, 1897. Ann. Mus. civ. stor. nat. Genova, ser. 2, **18**: 651 (type species: *Odontopyge paraguayensis* Silv., by original designation).—Attems, 1914, Zoologica **25**(66): 179 (name only).

Orthoporus (nec Silvestri) Schubart, 1947. Bol. Mus. Nac., Zool. **82**: 27, 52 in part, for *O. araguayensis* and *O. brasiliensis*).

Helicosolenus Attems, 1950. Ann. Naturh. Mus. Wien **57**: 247 (type species: *Helicosolenus lineolatus* Attems, by original designation). NEW SYNONYMY!

Diagnosis.—Orthoporoid spirostreptids in which the solenomerite, concealed within a broad lamellar expansion of the tibiotarsus, is spirally coiled in one or two complete turns. Telocoxite very short, scarcely surpassing distal end of paragonocoel. Collum of males not produced or lobed in front. Paraprocts each with a small spiniform process at their dorsal ends, as in the family Odontopygidae. Small species, body diameter from 2.0 to 4.0 mm.

Remarks.—The original description of Silvestri's *paraguayensis* is not explicit as regards form of the gonopods, but does show the expanded tibiotarsal blade and the very short projecting part of the telocoxite, and mentions the unusual modification of the paraprocts. In 1914, Attems remarked (1) that the genus probably belonged with the spirostreptids rather than the odontopygids, despite the form of the paraprocts. From that date the genus fell into total obscurity.

In 1947, Otto Schubart named two interesting Brazilian species, both quite small and with spined paraprocts, and agreeing well with published information about *Heteropyge*, but placed both in the genus *Orthoporus*. One of these species was described from immature specimens; the other from a large series of adults, and this latter form is of interest in that the solenomerite is shown to be spirally coiled.

Subsequently (1950) Attems erected the new genus *Helicosolenus* for two Paraguayan species in which the distal end of the telopodite is

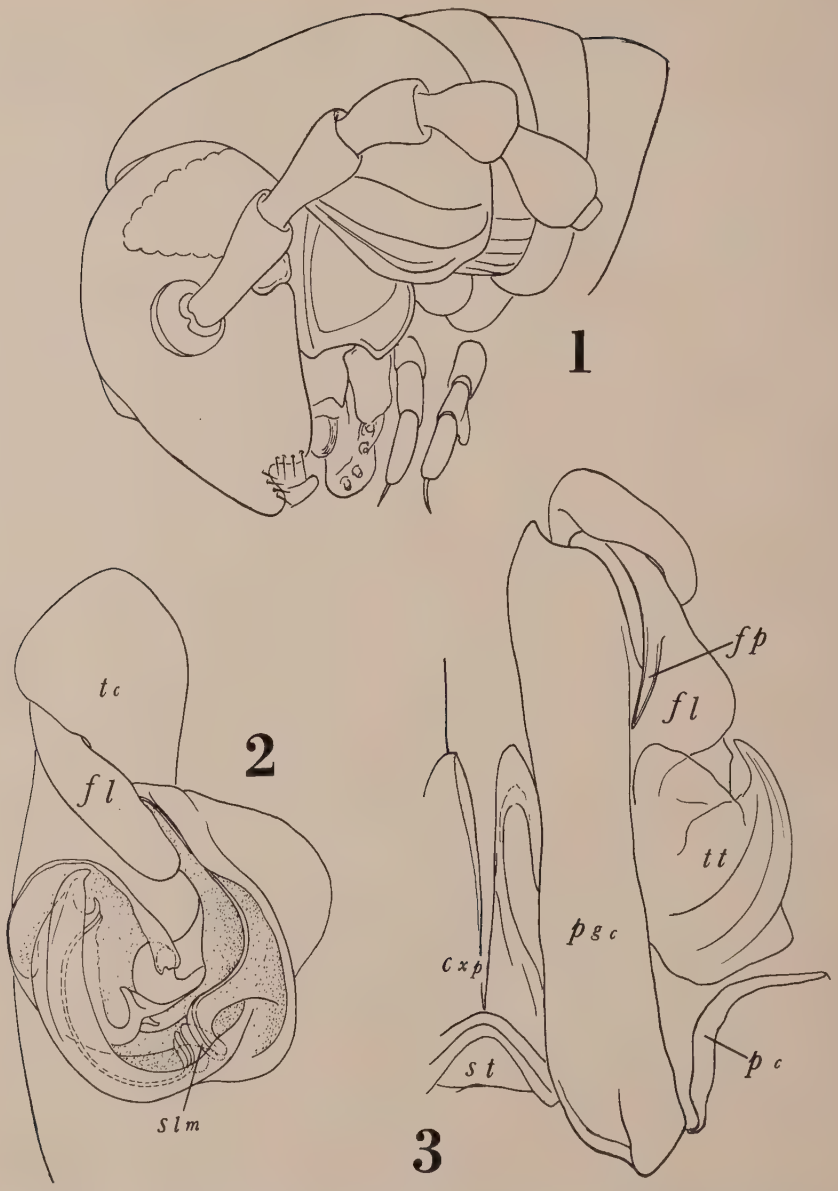


FIG. 1. *Heteropyge lineolatus* (Attems), slightly ventrolateral aspect of head and anteriormost body segments. FIG. 2. Anterior aspect of right gonopods. FIG. 3. Slightly dorsolateral aspect of right gonopods. (Abbreviations: *CxP*, inner process of the telocoxite; *FP*, femoral process; *FL*, femoral lobe; *Pc*, paracoxite; *Pgc*, paragonocoel; *Slm*, solenomerite; *St*, sternite; *Tc*, distal end of telecoxite).

". . . kellenartig verbreitet, der Kanal beschriebt in der Kelle 2 Spiralwindung." Both of these two species are small, and the telocoxite of the gonopod scarcely exceeds the distal end of the paragonocoel. With reference to the paraprocts, Attems states ". . . an seinem oberen Ende ein kleines Hockerchen" for *H. lineolatus* and ". . . am oberen Ende hockerig vortretend, was an die Odontopygidae errinert." for *solitarius*. Attems did not allude to the two Schubart species, but these are clearly congeneric with *H. lineolatus*.

The combination of unusual characters taken in combination is too striking to be overlooked or discredited as convergence. It is apparent that the species described by Silvestri, Schubart, and Attems are all congeneric, and that *Heteropyge* is the oldest name for the ensemble. The species known to me are the following:

Heteropyge paraguayensis (Silvestri) [from *Odontopyge*] 1895. Boll. Mus. Torino **10**(203): 11, fig. 12. Paraguay: Rio Apa.
Heteropyge araguayensis (Schubart), new combination [from *Orthoporus*] 1947. Bol. Mus. Nac., Zool. **82**: 27, figs. 27–30. Barra do Tapirape, Mato Grosso, Brasil.
Heteropyge brasiliensis (Schubart), new combination [from *Orthoporus*] 1947. Bol. Mus. Nac., Zool. **82**: 52, figs. 54–57. Aura, Para, Brasil.
Heteropyge lineolatus (Attems), new combination [from *Helicosolenus*] 1950. Ann. Naturh. Mus. Wien **57**: 247, figs. 86–88. Paraguay, without further locality.
Heteropyge solitarius (Attems), new combination [from *Helicosolenus*] 1950. Ann. Naturh. Mus. Wien **57**: 248, figs. 89–92. Paraguay, without further locality.
Heteropyge bidens (Schubart), new combination [from *Orthoporus*] 1945. An. Acad. Brasileira Cien. **17**: 84, figs. 15, 16. Ilha dos Pombas, Mun. Carmo, Rio de Janeiro.

The collection of the U. S. National Museum contains a male specimen of a *Heteropyge* from Cuiaba, Brazil, determined as *paraguayensis* by F. Silvestri and thereby constituting a homotype of that species. This milliped agrees in every particular with the description of Attems' *lineolatus*, and if Silvestri's identification is correct, *lineolatus* must fall into synonymy. Although there is no good *a priori* reason to challenge Silvestri's accuracy, Cuiaba is nonetheless 450 miles away from the Apa River, the type locality of *paraguayensis*. Recent experience has shown that small diplopods rarely occur as species units over such great distances, and preferring a certainty over an uncertainty, I propose to consider the Cuiaba specimen as representing Attems' species, and take this opportunity to publish several drawings which show more detail than those in the original description. The types of *lineolatus* came from an undesignated locality in Paraguay, perhaps in the northern part of the country.

The description of *lineolatus* is a good one, which I can elaborate only through providing more detailed drawings of the gonopods, and with the observation that the antennal sensory areas occur on articles 5 and 6, and are both very small and approximately equal in size. The long antennae extend back to the 5th segment. The mandibular stipes of the male provided with a conspicuous ventrodistal projection, as illustrated.

LITERATURE CITED

1. **Attems, C.** 1914. Die Afrikanische Spirotreptiden, nebst Ueberblick uber die Spirostreptiden orbis terrarum. Zoologica **25**(65–66): 1–235.
2. **Silvestri, F.** 1897. Systema Diplopodum. Ann. Mus. civ. stor. nat. Genova, ser. 2, **18**: 644–651.

3. **Hoffman, R. L.** 1953. Studies on spirostreptoid millipeds. I. The genus *Isoporostreptus* Silvestri. Lloydia **16:** 149–156; figs. 1–10.
4. **Hoffman, R. L.** 1955. Studies on spirostreptoid millipeds. II. The genus *Plusioporus* Silvestri. Lloydia **18:** 88–94; fig. 1.
5. **Hoffman, R. L.** 1956. Studies on spirostreptoid millipeds. III. The genera *Ptenogonostreptus*, *Trichogonostreptus*, and *Oreastreptus*. Lloydia **19:** 99–108; figs. 1–6.
6. **Hoffman, R. L.** 1957. Studies on spirostreptoid millipeds. IV. The genus *Anethoporus* Chamberlin. Lloydia **20:** 268–274; figs. 1–5.
7. **Schubart, O.** 1958. Sôbre alguns Diplopoda de Mato Grosso e Goiás, Brasil e a família Spirostreptidae. Arq. Mus. Nac., **46:** 203–252; figs. 1–31.
8. **Silvestri, F.** 1895. Viaggio del Dr. A. Borelli nella Republica Argentina e nel Paraguay: Chilopodi e Diplopodi. Boll. Mus. Zool. ed Anat. Comp. Torino **10**(203): 1–23.
9. **Attems, C.** 1950. Uber Spirostreptiden (Diplopoda). Ann. Naturh. Mus. Wien **57:** 179–257.
10. **Schubart, O.** 1947. Os Diplopoda da viagem do naturalista Antenor Leitao de Carvalho aos Rios Araquaia e Amazonas em 1939 e 1940. Bol. Mus. Nac., n. s., Zoologia **82:** 1–74· figs. 1–75.

The Thecal Structure of Peridinium Cinctum

G. S. Venkataraman and S. C. Mehta
(*Indian Agricultural Research Institute, New Dehli*)

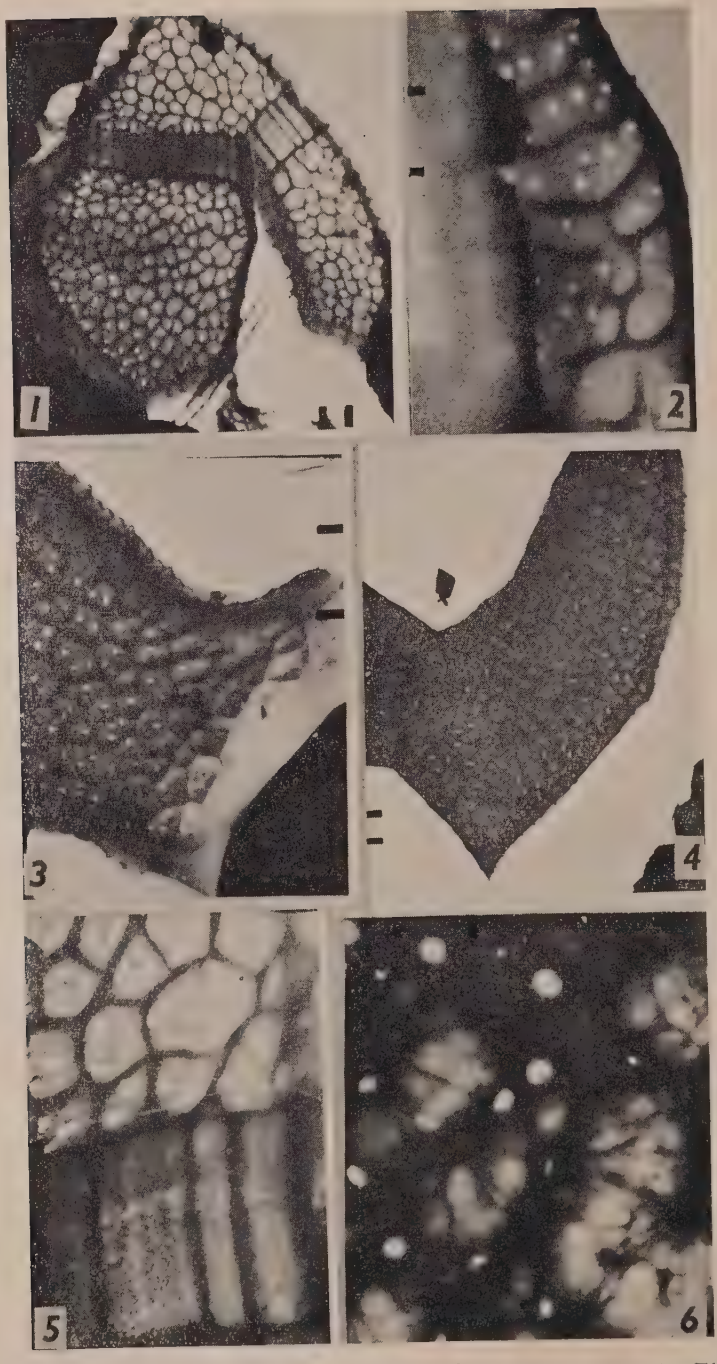
Previous authors (1, 2) reported the presence of small spines and cellulose microfibrils on the theca of the dinoflagellate, *Exuviella baltica*. The present communication deals with the thecal structure of the dinoflagellate, *Peridinium cinctum* (Muell) Éhrenberg (Sec: *Tabulata*) (3, 4). The material was found free-floating in the Najafgarh *jhil*, Delhi, during November-December, 1959, along with *Pediastrum boryanum* (Turp.) Menegh., *P. simplex* var. *duodenarium* (Bailey) Rabh., *Scenedesmus obliquus* (Turp.) Kütz., *Gloeotaenium Loitlesbergerianum* Hansg. and *Coelastrum Palii* sp. nov.[1]

One portion of the material was bleached with acetic alcohol (3: 1) and pressed between two clean glass slides. One drop of a diluted suspension of the pressed material was placed over a formvar film, dried, shadowed with palladium at an angle of about 30° and examined with a Philips electronmicroscope. Another portion of the material was kept in dilute potassium hydroxide overnight and after the alkali was thoroughly removed by washing, the material was examined as above.

The cells of *Peridinium cinctum* are globose or subglobose or broadly ovoid in front view and slightly flattened dorsiventrally as seen in polar view. The epitheca is high and broadly rounded and the hypotheca is also broadly rounded posteriorly. The cell wall is thick and the sutures between the plates are very pronounced and longitudinally striated. The plates are coarsely reticulate. The girdle lies transversely in a slightly submedian position on the left side and faintly spirals to a supramedian position on the right. The epitheca consists of four apical plates, three intercalary plates and six to seven perisingular plates while the hypotheca possesses two antapical plates and five postsingular plates. The cells are 36.1–57 μ broad and 39.9–60.8 μ long.

Under the electronmicroscope, both epitheca and hypotheca reveal a series of unequal polygonal plates (fig. 1). The plates further reveal strong reticulations (figs. 1, 3, 4), each of which is bulged in the middle (fig. 3), thus resulting in an uneven surface of the plate. Each reticulate portion has one to four simple pores (figs. 1, 3, 4). These pores may be of importance for the uptake of nutrients. The plates are connected to each other by intercalary bands which are broad in older individuals (fig. 1). The intercalary bands are longitudinally striated (fig. 5). On treatment with dilute potassium hydroxide, the cell wall reveals a fibrillar structure (fig. 6), thus suggesting that the basic structure of the theca is fibrillar. The girdle also possesses similar irregular polygonal reticulations, each of which possess two to seven simple pores (fig. 2).

[1]Venkataraman, G. S. and S. K. Goyal. A new species of *Coelastrum* (*Coelastrum Palii* sp. nov.) from India. Revue Algolog (in press).



FIGS. 1–6.—*Peridinium cinctum* (Muell) Ehr. FIGS. 1, 3, 4.—Electron-micrographs of the plates (note the broad intercalary bands in fig. 1 and the bulged reticulum in fig. 3). FIG. 2.—Girdle. FIG. 5.—Longitudinal ribs of the intercalary band. FIG. 6.—Fibrillar structure of the plate. (Scale 1 μ).

ACKNOWLEDGEMENT

The authors thank Drs. M. S. Randhawa, B. P. Pal, A. B. Joshi, R. V. Tamhane, and C. Dakshinamurti for their advice.

LITERATURE CITED

1. **Braarud, T.** 1955. Electronmicroscopy and oceanographic research. Papers in marine biology and oceanography. Pregmon Press Ltd., London. pp. 479–81 (cited from **Desikachary, T. V.** 1957. Electron microscopy and algology. Proc. Indian Acad. Sci. **46**: 54–64).
2. **Braarud, T., J. Markali** and **E. Nordli.** 1958. A note on the thecal structure of *Exuviella baltica* Lohm. Nytt. Mag. Bot. **6**: 43–45.
3. **Ehrenberg, C. G.** 1838. Die Infusionstierchen als vollkomene organismen. Voss, Leipzig. t. 22, p. 257.
4. **Schiller, J.** 1937. Dinoflagellatae (Peridineae), in **L. Rabenhorst's** Krptogamen-flora **10**(2): 152.

A Compilation of the Volvae of the United States[1]

C. G. LLOYD

INTRODUCTION

There are hundreds of botanists in the United States going over the same old ground year after year, flowering plants, when a practically unexplored field lies at their very doors. The study of the larger fungi, especially Agarics, is suffering for want of careful workers, and to-day, except in a limited field covered by Prof. Peck in the East, is practically unworked in this country. The chief difficulty is in a lack of literature. Little has been published on the Agarics of this country, save the numerous new species described by Prof. Peck and others, and these descriptions are so scattered through various publications that they are not available for the ordinary workers. Agarics should be studied by contrast and comparison, not each one as an isolated fact. We have several local lists, such as Johnson of Minnesota, Harkness of California, but they are for the most unreliable, and it were better for the science had they never been issued. It is to make a start to supply the literature needed that this pamphlet is compiled. It contains a synopsis of all the European species of Volvae reported from this country (a number no doubt errors) and all the "new species" described from this country. Many of the "new species" are based on colored plates or dried specimens sent to Europe and we opine that reliable work can not be done with such material. Agarics must be studied *fresh* and in the woods where grown, and it will be many years before the errors of our "dried specimen" descriptions of "new species" are eliminated. It is a fortunate circumstance to help the beginner in the study of our Agarics that the most of them are European species, and further that Europe has had a *Genius*, **Elias Fries,** who mastered the agarics of Europe and left us the result of his work in a completed form. (Epicriseos Systematis Mycologici, 1874). We advise every one who wishes to take up the study to obtain first a copy of Stevenson's British Fungi, (2 vols., 1886), the best work ever issued in English, and next (if possible) a copy of Fries' work mentioned before. Stevenson's work is largely based on Fries and the American worker can with Stevenson alone, determine a large number of the Agarics he may meet. You will find many difficulties in your path, but you are needed in the work, and if a number of botanists in different sections will undertake to make a careful *study* of their local mycological flora, not contenting themselves to be mere collectors of dried specimens, but *students* in the *woods* making notes, descriptions, comparisons, contrasts, of the Agarics they meet, from their observations on the *growing plants*, it will not be many years until we can have a systematic American work of value on the subject.

---

[1]This authoritative work is reprinted here to provide copy of one of the frequently sought publications of The Lloyd Library and Museum. Originally published in 1898 in Volume 1, *Mycological Writings* it has long been out of print. All details of the original manuscript, including page numbers and figure reproduction, have been included without editorial change.—Ed.

VOLVAE

The tribe "Volvæ" is characterized by the young plant being enclosed in a thick membrane, called a volva. (See Fig. 1.) This is the theoretical character, practically, it is of little service, as most species pass this stage of their life beneath the ground, and the volva is ruptured before it peeps up out of the earth.* Yet after a little observation, you will recognize a specimen belonging to this tribe, by the *remains* of the volva which you see. If you find an agaric with slightly attached scales (or warts as they are generally called) on the pileus, (see note,°) or if you find a cup at the base of the stipe, (as fig. 2, p. 3,) or if you find scales at the base of the stipe (as fig. 5, p. 5) or scars where the scales have fallen off, (as fig. 6, p. 6,) your plant most probably belongs to this tribe.

Fig.. 1—Section of a young Amanita in the volva.

Yet, there are many agarics† that have volvas‡ more or less pronounced and we must have some other way to limit the tribe.

In the first place, the tribe Volvæ belongs to the old genus Agaricus, as limited by Fries, viz:—The plants are soft and fleshy, they do not revive when dried—they are not tough, persistent or coriaceous. The gills are entire, thin, sharp—and not deliquescent when old. From the other tribes of the old genus Agaricus, the following is the technical distinction.

Hymenophore distinct from the stipe, and universal veil discrete from the epidermis of the pileus.°

*The books on edible mushrooms will tell you with great gravity, to always avoid eating a species where you find the young enclosed in a shell like an egg. It is good advice—but they are usually young phalloids which no one need be guarded against eating when mature. If you find an agaric in the egg shape, it is most probably Amanita cæsarea, (an edible species, but my advice is *don't eat any amanitas, and you will make no mistake,*) or Volvaria bombycina. Other species usually break their volvas before they appear out of the ground.

†The name agarics is a general term which we would apply to all fungi bearing gills, the genus Agaricus of the old botanists, and not restricted as limited by Fries.

‡*Coprinus picaceus* has a volva as evident as any Amanita. It breaks into scales on the pileus the same as an Amanita. Most *Coprinii* indeed have remnants of a volva, the micaceous particles on the pileus of the common species *micaceus*, the hairy covering of *fimentarius*, the scurfy particles which we see on the pileus of most other species are in the nature of a rudimentary volva. Likewise the dense coat of giuten covering young *Lepiota oblita, Pk.*, the white granules of *Lepiota cristatella Peck*, the thick gluten of many *Hygropharii* and *Cortinarii* are morphologically volvæ, though rudimentary. On the other hand some species of Amanita as *lenticularis* and *granulosa*, the volvæ are no more evident than in the cases cited above.

°These two terms will not convey much meaning to the beginner. The first means that the substances of the pileus and stipe are different, that they are not homogenous—hence the stipe is easily separable from the pileus, that it can be easily pulled out. It is also the case that the gills are free, that the[illegible] are not attached to the stipe, though a few plants that have pileus and stipe homogenous have [illegible]til' [illegible]d [illegible]m means that the scales of the pileus are not a part of the epidermis. [illegible]. [illegible] w[illegible]ored specimen with scales, may be puzzled to know whether it is an [illegible] or a Lepiota. The scales, or warts may be easily differentiated. In Amanita they adhere [illegible] closely) to the pileus, they can be pulled off without breaking the skin. In Lepiota they [illegible] edges where the epidermis is torn, they are similar to the fragments of skin around the one's finger nails known as hang nails.

The tribe Volvæ is divided artificially, according to the color of the spores.*

Genus 1.—**Amanita.**

Spores white.
This is our largest genus of this tribe, of which 38 species are recorded in the U.S.

Genus 2.—**Volvaria.**

Spores pink.
A small genus, only twelve species being recorded in the U. S.

Genus 3.—**Locellinia.**†

Spores ochraceous or ferruginous
A small genus not recorded in the U. S.

Genus 4.—**Chitonia.**

Spores fuscous—purple.
Not recorded in the U. S.

There are no black spores species of the tribe Volvæ known.

AMANITA.

The genus Amanita is a large family, about seventy-five species being known. The characters are those of the tribe Volvæ with white spores. Amanitas are all terrestrial plants—and mostly solitary in their habits. They are generally medium sized or large, frequently bright colored, and are conspicuous in the woods.

There have been two important publications on the Amanitas of the U. S. First, by Prof. Morgan, (In the Journal of Mycology, Vol. 3, 1887,) a compilation of the known species (28) at that time. Second, by Prof. Peck, (33rd Report, 1880), description of 14 New York species.

Forty-two species of Amanita have by various authors been ascribed to this country.

Of these, five are common, viz:—cæsarea, phalloides, muscaria, rubescens and vaginata, and will be met probably by every student.

Nine or less frequent—but their occurance well authenticated, viz:—sperta, virosa, pantherina, Frostiana, excelsa, solitaria, strobiliformis, volvata and farinosa.

Nine European species reported need further confirmation, viz:—recutita, mappa, spissa, nitida, aspera, lenticularis, adnata, nivalis, strangulata.

Four are either varieties, or are too poorly described to be recognized, viz:—pellucidula, verna, solesta and onusta.

The remaining fifteen, many described from *dried specimens* have not been otherwise recorded than by the original author.

The genus is easily divided into two subgenera, viz:—

Ring present. Subgenus, **Amanita,** (typical.)

Ring none. Subgenus, **Amanitopsis.**

SUBGENUS AMANITA (Typical.)

The species are naturally divided into five sections by the character of the separation of the volva, at the base of the stipe. For illustrations and further remarks see under each section.

Section 1.—Limb of volva free.

Section 2.—Volva definitely circumscissile.

Section 3.—Volva irregularly circumscissile.

Section 4.—Volva friable.

Section 5.—Volva rudimentary.

---

*To find the color of the spores, break off the pileus of the fresh agaric, and lay it gills down on a sheet of white paper. After a few hours, a deposit of spores will be found on the paper from which the color can be readily determined.

†In several English works this genus is called Acetabularia, and it is to be regreted that it had to be discarded, (on strict grounds of priority) as it was taken from the specific name of the only species of the genus known for many years.

SECTION 1.

Limb of the volva free, persistent as a cup surrounding the base of the stipe; splitting at the top, hence pileus usually naked, or only adorned with a few fragments of the volva, which accidentally adheres to it.

KEY.

Flesh yellow.....1 cæsarea.
Flesh white*
*Stipe equal or slightly thickened at base, volva appressed. (†)
*Stipe bulbous or volva globose. (‡)
†Margin striate, pileus pale brown,.....2 sperta.
†Margin even, stipe silky,.....3 recutita.
‡Pileus viscid, when young obtuse, spores globose,.....4 phalloides.
‡Pileus viscid, when young, obtuse, spores elliptical.....5 magnivelaris.
‡Pileus viscid, when young acute.....6 virosa.

1.—Amanita cæsarea, pileus, flesh, gills and stipe all yellow. Volva large, lax, white. Spores elliptical. Margin striate. (see Appendix p. 13.)

This species is very large and easily recognized by the yellow color of the gills and flesh, no other species having gills a decided yellow color—though some have a cream tint; also by the persistent large volva at the base of the stipe. At first the plant is bright orange, fading with age to yellow. It is of very wide distribution in this country though nowhere common. In Europe it occurs in the Southern portions and Fries never saw a living specimen.

Fig. 3.—Amanita phalloides.

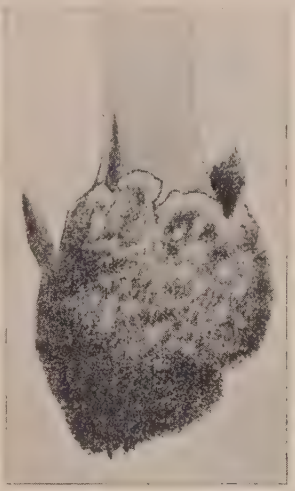


Fig 2.—Base of stipe with free volva.

Amanita pellucidula. Under this name Miss Banning describes a new species (Peck's 44th Report) differing from cæsarea in having even margin and white stem, but it is probably only a form of cæsarea. (See Appendix, p. 13.)

2.—Amanita sperta. Stipe equal, Pileus smooth, substriate on the margin, pale brown (or whitish) spores elliptical. (See Appendix p. 13.)

This species was described by Prof. Peck in 1878. It is very closely allied to A. porphyria of Europe. It is distinguished from all the following of this section by its substriate margin. It grows in dry, sandy soil. Also reported Ala., U. and E.; Ohio, Morgan's Mss.; Penn. Herbst.

3.—Amanita recutita. Stipe slender, not bulbose at the base, volva not globose, stipe silky. Pileus dry, (not viscid when young). (See Appendix p. 13.)

This species has been recorded common N. C., Curtis—also Atkinson. We suspect that determinations were made from specimens of Peck's "sperta."

4.—Amanita phalloides. Pileus smooth, even, obtuse when young. Stipe slender. Volva globose, free, surrounding the base of the stipe. Spores globose. (See Stevenson, p. 4.)

This is one of the most common species in all sections. It is extremely variable in color. The prevailing color is white, though it occurs yellowish, brown or blackish brown. In Europe the illustrations are mostly white, bright green or bright yellow. We have collected pale greenish yellow specimens in Penn., though the bright green and yellow forms are not recorded in this country. We have twenty different records where this plant is mentioned from California to Vermont and from Canada to North Carolina. (See illustration on previous page.)

Amanita verna. This species, or rather form of phalloides, for it has no distinguishing marks, has been recorded from various places. It is simply a slender, pure white form of phalloides which occurs in early spring.

5. **Amanita magnivelaris.** Stipe slender with a bulbose base tapering and rooting. Ring large. Spores elliptical. (See Appendix p. 13.)

Described by Prof. Peck in 1897. The author does not state that the "appressed remains" form a cup at the base of the stipe, but we judge they do from his comparing the plant to verna.

6. Amanita virosa. Pileus smooth, even, at first conical and acute. Stipe slender, volva globose. Spores globose. (See Stevenson, p. 3)

This species is pure white and is very close to phalloides differing only in the more acute form of the pileus especially when young. The stem is also more scaly. It has been recorded, N. C., Curtis; Ind., Underwood; Cal., H. & M.; Ohio, Lea; Alabama, U. & E.; Iowa, McBride,; New England. Sprague.

Fig. 4. Volva separating circumscissile.

SECTION 2.

Volva separating circumscisally the lower part remaining as a definite crown to the bulbous base of the stipe or a definite ring surrounding the lower portion of the stipe.

Several species in the following section by rights belong here, but most of them instead of the volva forming an entire ring at the base of the stipe, breaks up into scales often disposed in rings. The difficulty of deciding from the often inperfect description of American species where to place the species has induced me to throw all the doubtful ones into the next section.

KEY.

Stipe globose at the base, the bulb crowned by the entire ring,.....7 mappa.
Stipe enlarged (but not globose) at the base encircled by one or more rings,.....8 pantherina.

7. Amanita mappa. Pileus dry, even, covered with scales, volva circumscissile, the stipe globose at base. (See Stevenson, p. 4.)

All of the species of the preceding section have a free volva splitting at the top, hence the pileus is devoid of scales excepting a few fragments of the volva which accidentally may adhere to it, but in this species and those following the volva separates circumscisslle, the upper portion being carried up and broken into scales on the pileus.

It is recorded N. C., Curtis; New England, Frost; Minn., Johnson. We suspect the species does not occur in this country and that the above records are all based on unusually warty specimens of phalloides. Peck in his early days reports it, but *omits it entirely* in the more recent synopsis of the N. Y. series. The species could be readily recognized by the free entire crown to the globular bulbous base of the stipe, whereas in phalloides the free globular volva has the same general appearance, but it surrounds the base of the stipe.

8. Amanita pantherina. Pileus with a viscous pellicle, margin striate. Stem stuffed, then hollow, greaved at the base by the circumscissile volva. (See Stevenson, p. 6.)

Recorded from N. C. "frequent" by Schweinitz (under the name umbrina), also Penn. It can not be common in N. Y., as Peck does not report it until '83. Wisconsin, Bundy; N. C., Curtis; Indiana, Underwood; Cal., H. & M.; Cincinnati, Lea, Morgan; Ala., Atkinson; Iowa, McBride; Minn., Johnson; Dr. Herbst, (Penn.) finds it every summer in the jungle back of his house.

It appears to me that the species is characterized by a feature not found in many other species, and on which very little stress is placed in any of the books, viz.:—It is furnished at the base with two or more entire rings or collars "anello spurio" as Vittadini calls them.

These rings are very distinct and evident in every specimen preserved in my museum and in many of the European illustrations, notably Vittadini, (T. 39) (though poorly shown in Cook's figure.) They are formed by the circular laceration of the outer coat of the stipe near the base and have no relation to the scales often found at the bases of Amanitas which are remains of the volva.

European descriptions and plates usually represent this plant as brown, (olivaceus-umber) but in this country it is very light color, usually white with a slightly darker disk.

SECTION 3.

Volva separating in an irregular circumscissile manner, usually breaking up into scales disposed in rings.

Fig. 5. Volva separating irregularly circumscissal.

Notwithstanding the confusion regarding whether many American species belong in this section or the preceding, the sections are clearly distinct and all the confusion is a result of imperfect observations and records; also of great disadvantage that many of our American species have been described from dried specimens, where the author is not familiar with the growing plant.

In the preceding section the volva separates definitely circumscissile, as though cut around with a knife, leaving an entire circular scar (or usually a ring) at the base of the stem; in this section it breaks irregularly circumscissile leaving at the base of the stem scales (more or less persistent) which are disposed in rings.

KEY.

Plant colored (white in a form of muscaria.)*

Plant white.†

***Spores elliptical.‡**

***Spores globose,.....10 Frostiana.**

‡Margin of pileus striate, apex of stem striate from decurrent lines of the gills,.....9 muscaria.

‡Margin of pileus striate. Gills rounded, not reaching the stem.....12 excelsa.

‡Margin of pileus sulcate,.....11 russuloides.

†I conceive that the white species of this and the next section have been much confused, perhaps several of them are the same species re-described.

I cannot construct a key that would be of any value and only refer to the original descriptions in Appendix of this work. Most of these plants have solid stems, even margins, and usually large bulbous bases to the stipes. The white variety of *muscaria* can be readily distinguished from them by having neither of these characters.

Those who meet with a white species of Amanita should make a careful study and notes on it and compare it with the descriptions of the following species of this and the next section.

13. Candida.
14. Solitaria.
15. Polypyramis.
16. Strobiliformis.
17. Ravenelii.

NEXT SECTION.

Chlorinosma.
Daucipes, (said to be yellowish.)
Monticulosa.
Prairiicola.
Abrupta.
Nitida.

9. Amanita muscaria. Pileus in wet weather with a glutinous pelicle, margin striate, flesh yellowish under the pellicle. Spores elliptical. (See Stevenson, p. 5.)

This species is common and reported on every list that has been published from Nebraska east. It is not recorded from the Pacific Coast. It is an extremely variable plant as to color. It is usually orange when young, fading to yellow, though variations occur, which are brown, livid, yellow, and even pure white. European plates of the plant are the most brilliant hues, generally bright flaming red. The gorgeous colors do not occur in this country, the usual color being a pale yellow, though I have seen very young specimens bright crimson, but they fade as the plants mature. Prof. Peck has mentioned the following varieties based on size or color, but the varieties are not constant, "var. regalis," "var. umbrinus," "var. alba," "var. formosa."

10. Amanita Frostiana. Color orange or yellow resembling *muscaria*, margin striate, spores globose. (See Appendix, p. 13.)

This species was originally listed (though never published) by Frost, under the name Amanita affinis. In Peck's early work he called it Amanita muscaria var. minor, describing it as a distinct species and changing Frost's name in his revision of the genus. It resembles a small form of *muscaria* in every respect save it has globose spores. It has been reported N. Y., Peck; Mass., Frost; Wis., Bundy; Ala., U. & E.; Penn., Herbst.

11. Amanita russuloides. Color pale yellow. Margin of pileus widely striate-tuberculate. Spores elliptical. (See Appendix, p. 14.)

This is an extremely rare plant. It was discovered by Prof. Peck and described in 1871, but has not been met with by him or recorded by others since. Dr. Herbst a few seasons ago found a plant which he doubtfully referred here. Should it be again found it should be readily recognized by the widely striate tuberculate margin of the pileus, similar to Russula fragilis, (whence its name.)

12. Amanita excelsa. Pileus fuscous grey, stem stuffed becoming hollow, margin striate. Gills free, (not decurrent as a line down the stem.) (See Stevenson, p. 6.)

Reported N. C., Schweinitz and Curtis; Cal., H. & M.; Mass., Frost and Andrews; Minn., Johnson.

13. Amanita candida. Pileus even on margin. Stem solid bulbous. Annulus attached to the top of the stem. Spores elliptical. (See Appendix, p. 14.)

Described by Prof. Peck, 1897, from dried specimens collected by Underwood in Ala.

14. Amanita solitaria. Pileus even on margin. Stem solid, bulbous, narrowed into a long root-like projection below the ground. (See Appendix, p. 14.)

Appears rare in New York, as Peck does not report it until 1880. Maryland, Banning; Cincinnati, Morgan, Lloyd; Alabama, Atkinson and U. & E.; North Carolina, Atkinson; Penn., Herbst. I am inclined to think that more than one species are confused under the name. It is usual to consider the bulbous root, the bulb below the ground, as distinguishing this species, but I have a photograph of a specimen from Trexlertown, supposed to be this species devoid of all bulbous swelling to the root.

15. Amanita polypyramis. Prof. Morgan considers this a synonym for solitaria and I can see no points in its description that do not apply to this species. (See Appendix, p. 14.)

Described by Berkeley (1853) from dried specimens submitted by Curtis from North Carolina.

16. Amanita strobiliformis. (See Stevenson, p. 7.)

Rare in New York but usually attains a large size. Peck; Md., Banning; N. C., Curtis; Cal., H. & M.; Mass., Frost; Ala., U. & E.; Penn., Herbst.

I doubt very much if the plant usually ascribed to this species in this country belongs to it. The specimen that I have seen at Trexlertown, Pa., and specimens in my museum from Dr. Herbst characterized by a bulb above the ground, as emphasized by Prof. Peck in his description of the plant, do not accord with Vittadini's excellent plate either in the shape of the bulb, the shape of the warts, or the nature of the separation of the volva. The plate would indicate that separation is definitely circumscissile as in pantherina, throwing the plant into the preceding section, while the plant I have seen evidently belongs to this section the separation being similar to solitaria.

Besides all European authors describe the plant as having a subterranean bulb while in our plant the bulb is almost entirely above the ground.

17. Amanita Ravenelii. A species very closely related to the preceding. (See Appendix, p. 54.)

Described by Berkeley 1859, from dried specimen collected in Carolina by Ravenel. Atkinson since has collected specimens in Alabama which he referred to this species.

SECTION 4.

Volva wholly friable, breaking up into scales at the base of the stipe.

Fig. 6. Volva friable

This section is somewhat similar to the preceding, differing in the less permanent nature of the scales at the base of the stem. In some species they adhere so loosely that they hardly leave scars where they fall off.

KEY.

Color white or with yellowish scales.*
Color umber or olivaceous.†
Color reddish yellow or dingy red.‡

*Stem bulbous, Gills touching stem, Pileus yellowish, ... 18 daucipes.
*Stem bulbous, Gills touching, Pileus white ... 19 abrupta.
*Stem bulbous, Gills remote, ... 20 monticulosa.
*Stem not bulbose, Pileus 10 to 15 cm. broad, 21 chlorinosma.
*Stem not bulbous, Pileus 4 to 7 cm. broad, 22 prairiicola.

†Flesh clear white, warts small, adnate, ... 23 spissa.
†Flesh clear white, warts thick, large, ... 24 nitida.
†Flesh fuscous under the cuticle, ... 25 aspera.

‡Flesh quickly turning reddish when bruised, 26 rubescens.
‡Flesh yellowish unchangeable, ... 27 flavo-rubens.

18. Amanita daucipes. Plant saffron colored. Stipe solid with bulbous root. Warts pyramidal. (See Appendix, p. 14.)

This species is founded by Montagne on a colored drawing sent to Paris by Sullivant* from Columbus, Ohio., along in the fifties.

19. Amanita abrupta. Plant white. Stipe solid with bulbous base. Warts pyramidal. (See Appendix, p. 14.)

Described by Peck from dried specimens collected in Ala. by Underwood and Earle.

20. Amanita monticulosa. Pileus with discolored warts. (See Appendix, p. 14.)

Gills remote from stem, the only character where the distinction from the preceding two is obvious. Indeed, considering that all the descriptions have been drawn up from dried specimens it would not be surprising if all turned out to be the same thing.

Described by Berkeley from specimens sent from S. C. by Curtis who in his Catalogue says "common in sandy woods."

21. Amanita chlorinosma. A large white species with the margin of the pileus covered with a dense white coat of powdery substance; also characterized by a strong chlorine-like odor. (See Appendix, p. 15.)

Originally sent Peck from New Jersey by Austin. Reported from same state by Gerard and also from Ala. by U. & E.

22. Amanita prairiicola. Stem not bulbous at the base. Pileus only slightly warty. (See Appendix, p. 15.)

Described by Peck from dried specimens sent by E. Bartholomew which grew on the open prairie, Kansas. Not reported elsewhere.

23. Amanita spissa. Flesh white unchangeable. Pileus with a few not sharp warts. (See Stephenson, p. 8.)

The occurrence in this country is very doubtful. Reported from Maryland by Miss Banning and from Nova Scotia, Somers.

24. Amanita nitida. Flesh white unchangeable. Readily recognized by the thick angular warts. (See Stevenson, p. 9.)

This must be very rare in this country. Peck does not report it till 1889, and omits it entirely in his N. Y. monograph 1880. Reported from California, Harkness, (very poor authority.) Miss Banning says however "common in nearly every woods in Maryland," but I think she is mistaken.

25. Amanita aspera. Flesh not pure white. Pileus thickly covered with sharp warts. The illustrations of the plant remind one very much of Lepiota acutesquamosa. (See Stevenson, p. 9.)

Rarely reported from this country. N. C., (rare late in Autumn,) Schweinitz; Wisc., Bundy; Minn., Johnson.

26. Amanita rubescens. This species is readily distinguished from all other Amanitas known in this country by the flesh turning reddish when bruised. (See Stevenson, p. 8.)

This is one of the most common species in this country though it is not reported west of the Mississippi. At Mammoth Cave, Ky., I have seen the woods fairly covered with it. Around Cincinnati it is the most frequent species we meet, though all Amanitas are rare here. The warts densely cover the young plants but they easily separate and fall off, especially in wet weather, and after rains I have frequently seen mature specimens perfectly smooth. The plant can always be known by the red spots where it is bruised or worm eaten. The color of the bruised flesh is dull red, (inclined to brown) not bright as erroneously shown in Krombholz's figure.

27. Amanita flavo-rubens. Pileus reddish-yellow. Stipe hollow. (See Appendix, p. 15)

Species was founded on Sullivant's figure and specimens sent Montagne from Columbus, (See note* below.) Nuttall refers a plant here from W. Va.

Notwithstanding the author compares this plant only with rubescens I have a strong suspicion it is only a yellow form of muscaria. At Cincinnati, one hundred miles south of Columbus, yellow muscarias are all we find, and in addition European authors are accustomed to associate muscaria with the bright red form which occurs there.

SECTION 5.

Volva rudimentary, flocculose, wholly disappearing. But one species of this section has ever been ascribed to this country, viz:

28. Amanita lenticularis. Pileus naked, margin even. (See Stevenson, p. 10.)

---

*Over forty years ago Sullivant collected over 400 specimens of fungi around Columbus, Ohio, which he dried and also had water color drawings of them made by Robinson. These were sent to Montagne at Paris, France, who founded on them about sixty "new species" which he published in his "Sylloge." During the winter of 1897-98 I made a visit to Paris almost with the sole object of studying these specimens and securing photographs of these pictures, but was very much disappointed to learn from my friend N. Patouillard, that the entire set has been lost and is not preserved in any Museum in Paris. It is certainly to be hoped that the set will yet be found.

The illustrations of this species show neither warts nor traces of a volva and we should think a beginner would naturally think it was a Lepiota should he meet a specimen.

The occurrence of this species in the U. S. is exceedingly doubtful. Curtis lists it from N. C. but he questions his own determination and Bundy (extremely poor authority) reports it from Wisconsin.

SUBGENUS AMANITOPSIS

Ring none. Saccardo has separated the species devoid of a ring from the genus Amanita under the name Amanitopsis but inasmuch as it only complicates the system of classification we have preferred to retain them under one genus.*

Fig. 7. Amanita vaginata, (from photograph.)

Section 6.

Volva persistent, present when the plant is mature, though in some species so deeply in the ground that it is apt to be overlooked.

KEY.

Pileus deeply sulcate.*
Pileus striate (not sulcate)†
Pileus with even margin.‡
***Spore globose. Pileus with few warts,.....29 vaginata.**
***Spores globose. Pileus warty. Gills somewhat adnate, 30 velosa.**
***Spores elliptical, 31 agglutinata.**
†Margin striate, volva large, 32 volvata.
‡Margin even. Gills adnate, 33 adnata.
‡Margin even. Gills free, 34 pusilla.

29. Amanita vaginata. Pileus naked or with a few warts; deeply sulcate. Volva lax. Gills free. (See Stevenson, p. 11.)

There is no more common species in this country nor one that is more variable. The beginner is sure to make several species of it. It is recorded from every section, Cal. to the Atlantic. It varies in size from a couple of inches to ten inches, and in color from light umber to tawny orange. We have near Cincinnati two colors which no one at first would suppose could be the same species: first deep umber in the immediate vicinity of the city where I have never found the next; second, a bright orange tawny color about 20 miles south in Kentucky where it seems to be the only form to occur. The volva of this species is deep in the ground and will only be noticed by digging up the plant.

*Besides according to Stevenson the ring is present in vaginata. He makes the rather paradoxical statement, "the ring though obsolete is present, more or less conspicuously at the base of the stem, disclosed in the volva." We have never seen any trace of a ring.

30. Amanita velosa. (See Appendix, p. 15.)

A western plant very closely related to vaginata (too close we are afraid, taking into account the variability of this species) described by Prof. Peck, from dried specimens sent by McClatchie. It differs in the more numerous and thicker warts and in somewhat adnate gills.

31. Amanita agglutinata. Spores elliptical. Pileus white. Stipe solid. (See Appendix, p. 15.)

Described from dried specimens sent Berkeley by Curtis from S. C. Not reported otherwise. Very close to vaginata but said to differ in solid stipe, more viscid pileus and elliptical spores.

32. Amanita volvata. Pileus striate (not sulcate). Spores elliptical, volva large, persistent, firm. (See Appendix, p. 15.)

A well marked species described by Peck in 1871 and widely distributed. N. Y., Peck; Maryland, Banning; Mass., Frost; Cin., Morgan, Lloyd, (it grows here only in one rather marshy woods at College Hill.) Ala., U. & E., N. C., Atkinson; Penn., Herbst. Nothing demonstrates how little attention was paid to the Agarics by Schweinitz after he went to Penn. than the fact that he entirely overlooked this characteristic species. That it is common on his collecting ground we know from personal collections.

Amanita soleata. (See Appendix, p. 13.) No doubt the same as volvata, poorly, (and subsequently,) described by Howe.

33. Amanita adnata. Margin even. Gills adnate. (See Stevenson, p. 12.)

A plant said to be rigid like a Russula. Reported from this country by four observers, but none of them trustworthy and its occurrence is doubtful. Cal., Harkness; Wis., Bundy; Nova Scotia, Sommers; Minn., Johnson.

The volva said to break into scales, though the excellent figure of Saunders, Smith and Bennett shows a distinct cup-shape volva.

Amanita onusta. (See Appendix, p. 16.) The folly of a beginner in Mycology describing new species when he has not even a passing acquaintance with the old, cannot be too severely condemned. It only encumbers the science with a lot of useless synonyms.

34. Amanita pusilla. Pileus even. Gills free. Stipe bulbous.

Described by Prof. Peck, 1897. A little plant pileus about one inch broad. (See Appendix, p. 16.)

Section 7.

Volva rudimentary, floccose, or soon breaking into scales.

KEY.

Large plants, 8 cm. or more.*
Small plants, 5 cm. or less.†
***Pileus white or slightly tinged with yellow, warts few, 35 nivalis.**
***Pileus warty, grayish brown, ... 36 strangulata.**
†Pileus mealy, grayish brown, ... 37 farinosa.
†Pileus pubescent, yellow, ... 38 pubescens.

35. Amanita nivalis. Pileus naked or with a few warts. Spores globose. (See Appendix, p. 16.)

This species is considered by Fries a form of vaginata but Prof. Peck finds a plant which he considers distinct, chiefly because the volva breaks up into scales. As Greville's figure shows a prominent entire volva (and Greville is remarkably accurate in his excellent figures) and besides, he describes it as *persistent*, we opine that Prof. Peck's plant belongs somewhere else, perhaps a new species. Also reported Ala., Atkinson; West Va., Nuttall.

36. Amanita strangulata. Pileus grayish-brown, thickly covered with warts. (See Stevenson, p. 11.)

Berkeley (Outlines, p. 92,) describes a plant under the name Ceciliæ stating that it differs from vaginata in having a stuffed stem instead of a few cottony fibers. Fries united Berkeley's plant to his strangulata which he chiefly distinguishes from vaginata in having the pileus closely covered with broad close scales. Smith states the English plant has oval spores. Peck that the American plant has globose spores and the English plate of Saunders, Smith and Bennett shows globose spores. Very rare. Prof. Peck has found it but once, (twenty years ago on Long Island.) Frost reports it from Massachusetts and Bundy and Johnson thought they found it in Wisconsin and Minnesota.

37. Amanita farinosa. Pileus deeply striate; mealy with a white powder very dense near the center of the pileus. (See Appendix, p. 16.)

A very small species described by Schweinitz from N. C. Reported also N. Y., Peck; Cincinnati, Morgan Mss; New Jersey, Ellis; Penn., Herbst.

38. Amanita pubescens. Pileus pubescent, yellow. (See Appendix, p. 16.)

Another small species never reported since orginally described by Schweinitz from N. C. seventy-five years ago. If met with it should be readily recognized by its small size and pubescent pileus.

VOLVARIA.

The genus Volvaria is rosy-spored corresponding to Amanita, excepting the spores are not white. None of the species have rings. The volva is firmer and not friable as in many Amanitas, hence it usually remains as a cup around the base of the stipe and does not break up and seldom forms warts as in most of the Amanitas.

A few Volvarias grow on rotten wood, but most of the species are found in rich mould or manured ground. One grows on decaying fungus.

KEY.

Plant growing on rotten wood.*
Plant growing on decaying fungus.†
Plant growing on the ground.‡
*Pileus dry,.....1 bombycina.
*Pileus viscid.....2 Peckii.
†Plant growing on decayed fungus,.....3 Loveiana.
‡Plant very small, less than an inch.¶
‡Plant medium, 2 inches or more.§
¶Pileus even, silky,.....4 parvula.
¶Pileus striate,.....5 striatula.
¶Stipe with spreading hairs,.....6 pubescentipes.
§Pileus dry.‖
§Pileus viscid.£
‖Pileus even,.....7 volvacea.
‖Pileus striate.⁋
⁋Volva cup shape,.....8 Taylorii.
⁋Volva merely a rim,.....9 emandatior.*
£Pileus fulvous-ochraceous,.....10 viscosa.
£Pileus grey or umber at disk,.....11 speciosa.
£Pileus fulginous,.....12 gloicephala.
£Pileus white.....9 emandatior.*

Fig. 8. A young plant Volvaria bombycina. (From photograph.)

1. Volvaria bombycina. Pileus campanulate then expanded, dry silky fibrillose. (See Stevenson, p. 183.)

A large plant growing on rotten wood recorded from all sections of the country. Though of wide distribution it is nowhere abundant. It usually grows on maple frequently being found on the decay around a sugar tap. Farlow records it on oak and we have seen it on beech. Millspaugh in reporting it gives its habitat "on dead insect" which is evidence enough that he is in error. The volva is quite thick and we frequently find the plant in the egg state looking like a young phalloid.

2. Volvaria Peckii. Pileus thin, convex, viscid. (See Appendix, p. 16.)

Described from a single specimen collected in N. Y. by Atkinson and never recorded elsewhere.

3. Volvaria Loveiana. Pileus white, silky, margin involute. (See Stevenson, p. 184.)

Though there is no printed record of this plant in the United States, we have been favored with specimens from Prof. John Dearness, London, Canada, which grew on a decaying Clitocybe monadelphus. It is rare in Europe and Prof. Dearness' find is of great interest. The peculiar habitat of the plant (decaying agarics) would enable it to be recognized at once.

(*) The author does not state whether the pileus is viscid or dry, a fatal omission in describing a Volvaria. He no doubt did not know however, as he described it from a dry specimen.

4. Volvaria parvula. Plant small. Pileus even, silky. (See Stevenson, p. 186.)

This plant is recorded from N. C., Schweinitz and Curtis; Md., Banning; Mass., Frost; Wisc., Bundy; New England, Sprague; but how many records are based on the following plant it is difficult to say.

5. Volvaria striatula. Pileus thin, silky, striate on the margin. Plant small. (See Appendix, p. 16.)

Described by Prof. Peck from dried specimens sent from Kansas by Bartholomew. The *small* species of volvaria deserve further study. I have before me a fresh specimen found in a hot house of parvula agreeing with the description and Cooke's, Krombholz' and Patouillard's figures, but it is *not* umbonate (nor do the three figures so show it) and the margin is even, (as the figures show) though it dries striate. I have alcoholic specimens of what I took at the time of collection to be the same species which shows faintly striate. I have another species (dried, and in alcohol) agreeing with the description in being *umbonate* (and Fries underscores umbonate) and it is also *striate*. Cordier's figure of "parvula" is *strongly striate*. Additional specimens and notes on the small species of Volvaria are earnestly desired.

6. Volvaria pubescentipes. A small plant about an inch high, distinguished by the spreading hairs on the stipe. (See Appendix, p. 17.)

Described by Peck in 1875. No records since save Morgan's Mss. from Cincinnati. Saccardo spells the name pnbipes but whether intentional or a misprint is doubtful.

Fig. 9. Volvaria volvacea. (From photograph.)

7. Volvaria volvacea. Pileus campanulate then expanded. Fibrils appressed, dark. Volva lax. (See Stevenson, p. 183.)

This is a much smaller plant than bombycina and grows in the ground. It is usually found in hot houses, cellars, etc., though we once collected a specimen at the roots of a tree in the woods. It occurs every year in the cellar of our drug store. Reported also N. C., Schweinitz; Minn., Johnson; Preston, O., Morgan Mss.

8. Volvaria taylorii. Pileus conical-campanulate, deeply striate. (See Stevenson, p. 184.)

Only reported from this country on very doubtful authority. Minn., Johnson.

9. Volvaria emendatior. Pileus umbonate, smooth, white. Volva forming merely a rim around the stem. (See Appendix, p. 17.)

Described by Berkeley from dried specimens from New England, Sprague, and N. C., Curtis. The author does not state whether the pileus is viscid or dry which leaves us in doubt in which section to place it, though it is probably viscid as most smooth species are. There is no other record of the plant.

10. Volvaria viscosa. Pileus campanulate-convex, very viscous, ochraceous. Stipe bulbous. (See Appendix, p. 17.)

The habitat is not stated though presumably in the ground. Described from Nebraska by Clements, no other record.

11. Volvaria speciosa. Pileus grey, umber at the disk, viscous. Stipe villous at the base. (See Stevenson, p 185.)

"Common in cultivated soil, especially grain fields and along roads. A fine edible Agaric and our most abundant one in California"—McClatchie. Not reported elsewhere save Wisc., Bundy, and that doubtful.

12. Volvaria gloiocephala. Volva-fuliginous, glutinous, striate on the margin. Stipe smooth. (See Stevenson, p. 185.)

Cal., H. & M.; Cincinnati, Morgan Mss.; Minn., Johnson.

APPENDIX.

Descriptions* of American Volvae and references to European species reported from this country.

AMANITA, (Typical.)

Section 1.

Amanita cæsarea. Pileus hemispherical, then expanded, smooth, bright red or orange, fading to yellow, widely and *distinctly striate on its margin*; lamellæ free, *yellow*; stem equal or slightly tapering upward, flocculose, stuffed with cottony fibrils or hollow, yellowish, bearing a yellowish annulus near the top and inserted at the base in a *large loose membranous white volva*; spores elliptical, 8-10 mc. long. Plant 12-20 cm. high, pileus 10-20 cm. broad, stem 8-12 mm. thick. (Peck, 33rd Rep.)

Amanita pellucidula. Pileus at first campanulate, then expanded, slightly viscid, fleshy in the center, attenuated at the margin, smooth, bright red, deeper at the top, shaded into clear transparent yellow at margin, glossy, flesh white, unchanging; lamellæ ventricose, free, numerous , yellow; ring descending, fugacious; stem stuffed. (Banning, Peck's 44th report.)

Aminita spreta. Pileus subovate, then convex or expanded, smooth or adorned with a few fragments of the volva, substriate on the margin, whitish or pale-brown; lamellæ close, reaching the stem, white; stem equal, smooth, annulate, stuffed or hollow, whitish, finely striate at the top from the decurrent lines of the lamellæ, not bulbous at the base, but the volva rather large, loose, subochreate; spores elliptical, generally with a single large nucleus, 10-12 mc. long, 6-8 mc. broad. Plant 10-11 cm. high, pileus 7-12 cm. broad, stem 8-12 mm. thick. Ground in open places. (Peck 32nd Report.)

Amanita recutita. Pileus convex then explanate, *dry* glabrous, often squamulose with fragments of the volva; margin almost even; stipe stuffed then hollow, attenuate, *silky*, vaginate with the narrow appressed margin of the obliterated circumscissile volva. (Fries Epic., p. 19.)

Amanita phalloides. (Stevenson, p. 4. Fries Epic., p. 18.)

Amanita magnivelaris. Pileus convex or nearly plane, glabrous, slightly viscid when moist; even on the margin, white or yellowish-white, lamellæ close, free, white; stem long, nearly equal, glabrous, white, furnished with a large membranous volva, the bulbous base tapering downward and radicating; spores broadly, elliptical, 10 mc. long, 6-8 mc. broad. Pileus 7-12 cm. broad, stem 12-18 cm. long 8-12 mm. thick. Solitary in woods. (Peck, 50th Report.)

Amanita virosa. (Stevenson p. 3. Fries Epic., p. 18.)

Section 2.

Amanita mappa. (Stevenson p. 4. Fries Epic., p. 19.)

Amanita pantherina. (Stevenson, p. 6. Fries Epic., p. 21.)

Section 3.

Amanita Frostiana. Pileus convex or expanded, bright-orange or yellow, warty, sometimes nearly or quite smooth, striate on the margin; lamellae free, white or slightly tinged with yellow; stem white or yellow, stuffed, bearing a slight, sometimes evanescent annulus, bulbous at the base, the bulb *slightly margined* by the volva; spores *globose*, 7-10 mc. in diameter. Plant 5-8 cm. high, pileus 2½-5 cm. broad, stem about 4 mm. thick. (Peck, 33rd Report.)

Amanita muscaria. (Stevenson, p. 5. Fries Epic., p. 20.)

Amanita excelsa. (Stevenson p. 6. Fries Epic., p. 21.)

*While no quotation marks are used it must be understood that these are taken from original descriptions. European species described in Stevenson are not reproduced here, though when the species is not English, descriptions are drawn either from Fries' Epicrisis or Peck's summary of New York species.

Amanita russuloides. Pileus at first ovate, then expanded or convex, rough with a few superficial warts, or entirely smooth, viscid when moist, widely striate-tuberculate on the margin, pale yellow or straw color; lamellæ close, free, narrowed toward the stem, white; stem firm, smooth, stuffed, annulate, equal or slightly tapering upward, bulbous; annulus thin, soon vanishing; volva fragile, subappressed; spores broadly elliptical, 10 mc. long, 7½ mc. broad. Plant 5-8 cm. high, pileus 4-5 cm. broad, stem 6-10 mm. thick. Grassy ground in open woods. (Peck, 25th Report.)

Amanita candida. Pileus thin, broadly convex or nearly plane, verrucose with numerous small erect angular or pyramidal easily separable warts, often becoming smooth with age, white, even on the margin; flesh white; lamellæ rather narrow, close, reaching the stem, white; stem solid, bulbous, floccose-squamose, white, the annulus attached to the top of the stem, becoming pendent and often disappearing with age, floccose-squamose on the lower surface, striate on the upper, the bulb rather large, ovate, squamose—not margined, tapering above into the stem and rounded, or merely abruptly pointed below; spores elliptical, 10-13 mc. long, 7 mc. broad. Pileus 7-15 cm. broad, stem 6-12 cm. long, 10-16 mm. thick, the bulb 2½ to 4 cm. thick in the dried specimens. (Peck, Bull Torr. Club. Vol. 24, p. 137-138.)

Amanita solitaria. Pileus convex or plane, *warty*, white or whitish, *even* on the margin; lamellæ reaching the stem, white or slightly tinged with cream color; stem at first mealy or scaly, equal, *solid*, white, bulbous, the bulb scaly or mealy, *narrowed below into a root-like prolongation, annulus lacerated*, often adhering in fragments to the margin of the pileus and lamellæ; spores elliptical-oblong, 7-12 mc. long, 6 mc. broad. Plant, 10-20 cm. high, pileus 8-15 cm. broad, stem 8-12 mm. thick. (Peck, 33rd Report.)

Amanita polypyramis. Pileus 15 cm. across, pure white, shining areolate, beset with thick, rather small, pointed pyramidal warts, especially in the center. Stem, 15-20 cm. high, 2-5 cm. thick, solid, incrassated and rooting below, almost smooth with the exception of a few little narrow transparent scales; ring broad, evanescent. Gills white, reaching the stem, quite linear at the extremity. Odor strongly alkaline. (Berk., Ann and Mag. Nat. Hist. Vol. 12, 2nd series, p. 417.)

Amanita strobilformis. (Stevenson, p. 7. Fries Epic., p. 21.)

Amanita Ravenelii. Pileus 10 cm. across; convex broken up into distinct areae, each of which is raised into an acute rigid pyramidal wart; stem 8 cm. high, 2½ cm. or more in thickness at the base, furnished with a thick warty volva, and a deflexed ring. (Berk., Ann and Mag. Nat. Hist. Vol. 4, 3rd series, p. 284.)

Section 4.

Amanita daucipes. Volva fugacious. Pileus hemispherical-globose, compact, uniformly warted. Warts pyramidical, saffron color. Flesh soft white. Stipe solid with a bulbous root, with a constricted cortina above and squamulose downward. Gills narrow, touching (the stipe) attenuate both ways. Stipe 12-15 cm. long, pileus 6 cm. broad, veil fibrillose extending from the margin of the pileus to the apex of the stipe, fugacious. In cultivated fields. (Montagne Sylloge p. 96.)

Amanita abrupta. Pileus thin, broadly convex or nearly plane, verrucose with small angular or pyramidal erect somewhat evenescent warts, slightly striate on the margin, flesh white; lamellae moderately close, reaching the stem and sometimes terminating in slightly decurrent lines upon it, white; stem slender, glabrous, solid, bulbous, white, the bulb abrupt, subglobose, often coated below by the white persistent mycelium, the annulus membranous, persistent; spores broadly elliptical or subglobose, 7-10 mc. long, 6-7 mc. broad. Pileus 5-10 cm. broad; stem 6-10 cm. long, 6-8 mm. thick. (Peck, Bull. Torr. Club. Vol. 24, p. 138.)

Amanita monticulosa. Pileus 6-8 cm. across, convex, areolate, with a wart in the center of each areola; those toward the margin consisting of soft threads meeting in a point, but sometimes simply flocculent, the central warts angular, pyramidal, truncate, discolored. Stem bulbous, scaly, flocculent, white; veil

thick at length distance. Gills free, ventricose, remote, forming a well defined area around the top of the stem. The warts are not hard and rigid as in A. nitida, and the free remote gills separate it from that and the neighboring species. (Beck., Ann and Mag. Nat. Hist. Vol. 12, 2nd Ser. p. 418.)

Amanita chlorinosma. Pileus convex or expanded, warty on the disk, covered on the even margin with a light powdery at length evanescent substance, white; lamellae white; stem nearly cylindrical, stout, deeply penetrating the earth; spores broadly elliptical, 7-10 mc. long, odor distinct, chlorine-like. Plant 15-18 cm. inches high, pileus 10-15 cm. broad, stem 3-5 cm. thick. (Peck, Bot. Gaz., Vol. 4, p. 137.)

Amanita prairiicola. Pileus thin, convex, slightly verrucose, white, more or less tinged with yellow, even on the margin, flesh white; lamellae rather broad, subdistant, reaching the stem, white; stem equal or slightly tapering upward, somewhat squamose toward the base, white or whitish, the annulus persistent; spores large, broadly elliptical, 12-14 mc. long, 7-9 mc. broad. Pileus 4-7 cm. broad, stem 5-6 cm. long, 4-8 mm. thick. Bare ground on open prairies. (Peck, Bull. Torr. Club. Vol. 24, p. 138.)

Amanita spissa. (Stevenson p. 8. Fries Epic., p. 23.)

Amanita rubescens. (Stevenson p. 8. Fries Epic., p. 23.)

Amanita flavo-rubens. Pileus convex, then expanded, reddish-yellow, strewn with thick unequal mealy warts. Stipe stuffed or hollow, tall, squamulose, naked bulb at the base, mealy above. Ring above, reflexed, lacerate. Gills, close, white, attenuated and touching (the stipe). Pileus 9 cm. broad, obscurely umbonate, variegated with red and yellow. Warts yellowish, thinly spread. Margin striate. Stipe 15 cm. long, bulbose at base, a cm. thick in the middle. Spores white, globose, 10 mc. in diameter. (Montagne Sylloge p. 96.)

Section 5.

Amanita lenticularis. (Stevenson p. 10. Fries Epic., p. 26.)

Section 6.

Amanita vaginata. (Stevenson p. 11. Fries Epic., p. 27.)

Amanita velosa. Pileus at first subglobose, then campanulate or nearly plane, generally bearing patches of the remains of the whitish felty or tomentose volva, elsewhere glabrous, becoming sulcate-striate on the margin, buff or orange-buff, flesh compact, white; lamellae close, reaching the stem, subventricose, pale cream color; stem firm, at first tomentose and attenuated at the top, then nearly equal, stuffed, white or whitish, closely sheathed at the base by the thick volva; spores globose, 10-12 mc. broad. Pileus 5-10 cm. broad; stem 7-10 cm. long, 6-8 mm. thick. (Peck, Bull., Torr. Club. Vol. 22 p. 485.)

Amanita agglutinata. White, pileus 2-5 cm. broad, scaly from the remains of the volva, margin thin. Stem 1-4 cm. high, 4 mm. thick, enlarged at the apex bulbous at the base, furnished with a volva whose margin is free. Ring wanting. Gills broad, ventricose, round and free behind. Spores white, elliptical. (Berk, Ann, Jour., Arts and Sci., 2nd Ser., Vol. 8, p. 401.)

Amanita volvata. Pileus fleshy, convex, at length expanded, striate on the margin sprinkled with small floccose scales, whitish, the disk pale brown; lamellae close, free, white; stem equal or slightly tapering upward, stuffed, minutely floccose, scaly, ringless, whitish; volva large, firm, loose; spores subelliptical 6 mc. long, plant, 5-7 cm. high, pileus as broad, stem, 6-8 mm. thick. (Peck, Report 24, p. 60.)

Amanita soleata. Pileus 5-7 cm. broad, fulvous brown, somewhat uneven, with patches of tomentum, sprinkled with a fine, dingy yellow powder; margin thin, striate; stem 5 cm. high, 6-8 mm. thick, ringless, smooth, attenuated downwards, fistulose; volva 2-3 cm. broad, even, entire or with a shallow sinus; gills whitish, changing to a cinerous brown in drying. (Howe Bull. Torr. Bot. Club. Vol. 5, p. 42.)

Amanita adnata. (Stevenson p. 12. Fries Epic. p. 28.)

Amanita onusta. Pileus 12-15 cm. broad, brownish gray, clothed with dust colored warts which easily rub off, (persistent about the dark center) leaving spots of a deeper brown; margin thick, not at all striate; stem 7 cm. high, 2½ cm. thick, attenuated upwards, enlarging as it enters the cap, farinose, ringless, white, stuffed, concentrically squamulose below, the large bulb firmly rooting. Flesh and gills white, the latter changing to fulvous hue in drying. Slightly acrid. Stem very glutinous, at length hard and fibrous. (Howe, Bull. Torr. Bot. Club. Vol. 5, p. 42.)

Amanita pusilla. Pileus thin, broadly convex or nearly plane, subglabrous, slightly umbonate, even on the margin, pale brown; lamellae narrow, thin, close, free, becoming brownish; stem short, hollow, bulbous, the bulb margined by the remains of the membranous volva, spores broadly elliptical, 5-6 mc. long, 4 mc. broad. Pileus about 2½ cm. broad; stem 1½-2½ cm. long, 2-4 mm. thick. (Peck, 50th Report.)

Section 7.

Amanita nivalis. Pileus at first ovate, then convex or plane, smooth, *striate on the thin margin, white,* sometimes tinged with yellow or ochraceous on the disk, flesh white; lamellae subdistant, white, free; stem equal, rather tall, nearly smooth, *bulbous,* stuffed, white, the volva very fragile, *soon breaking up into fragments or sometimes persisting in the form of a collar-like ring at the upper part of the bulb*; spores globose, 7-10 mc. in diameter. Plant 10-15 cm. high, pileus 5-7 cm. broad, stem 4 8 mm. thick. (Peck, 33rd Report, p. 48.)

The above is Prof. Peck's description of the American plant. As stated in part 1, we do not think it applies to Greville's plant.

Amanita strangulata. (Stevenson p. 11. Fries Epic., p. 27.)

Amanita farinosa. Pileus mealy, with plicate margin. Gills entire, white, unchangeable. Stipe bulbose, solid (*) livid. Related to vaginata but smaller and not furnished with a volva. (†) Pileus with the margin elegantly plicate, mealy, principally in the center, where the powder is a copious heap and can be wiped off. An inch broad. Stipe mealy. Ring wanting. Plant two inches high. (Schw., Syn. Fung. Car, Sup. No. 553.)

(*) Peck states "stuffed or hollow."

(†) It is evident that Schweinitz description "nec volva instructa" must not be taken *literally* else it would not be an Amanita. Peck describes the volva as evanescent.

Amanita pubescens. Pileus pubescent, yellow, margin involute. Gills white. Stipe short, bulbous, pubescent, white, becoming yellowish. Pileus covered with a thin pubescence. Stipe short, scarcely exceeding an inch. Bulb fleshy. Volva vanishing. Ring none. (Schw., Syn. Fung. Car. Sup. No. 554.)

VOLVARIA.

Volvaria bombycina. (Stevenson, p. 183. Fries Epic., p. 182.)

Volvaria Peckii. Pileus thin, convex, glabrous, viscid, finely striate on the margin, whitish; lamellae rather close, thin, pale flesh color; stem slightly tapering upward, glabrous solid, whitish, with a loose, well developed membranous volva at the base; spores even, subelliptical, 7-10 mc. long, 5-6 mc. broad, stem 7-9 cm. long, 6-8 mm. thick. (Peck, 48th Report.)

Volvaria Loveiana. (Stevenson p. 184. Fries Epic., p. 182.)

Volvaria parvula. (Stevenson p. 186. Fries Epic., p. 184.)

Volvaria striatula. Pileus thin, convex or nearly plane, minutely silky, striate on the margin and somewhat reticulate when dry, white; lamellae narrow, free, white, becoming flesh color; stem short, glabrous, white, with the cup-like remains of the membranous volva at the base; spores subglobose, uninucleate, 7 mc. long, nearly as broad. Pileus 1-2 cm. broad; stem about 3 cm. long, 1-2 mm. thick. Wet ground under weeds. (Peck, Bull. Torr. Club. Vol. 22, p. 488.)

Volvaria pubescentipes. Pileus convex, dry, white, clothed with minute hairy squamulose or reflexed fibrils, fimbriate on the margin; lamellae close, free, white, then flesh colored, sometimes minutely serrated or eroded on the edge; stem slender, subequal, pubescent; volva subappressed, white; spores elliptical, 6-7 mc. long, usually containing a single nucleus. Plant about 2 cm. long, pileus 1-2 cm. broad, stem 2 mm. thick. (Peck, 29th Report.)

Volvaria volvacea. (Stevenson p. 183. Fries Epic., p. 182.)

Volvaria Taylorii. (Stevenson p. 184. Fries Epic., p. 183.)

Volvaria emendatior. Pileus 7 cm. across, flat, with an obtuse umbo, smooth white; margin thin striate; stem 7 cm. high, 8 mm. thick, slightly incrassated above and below, very slightly arachnoid-fibrous, solid, volva forming merely a rim; gills ventricose, remote, free and rounded behind, white, at length flesh colored, extending in front beyond the ragged margin of the pileus as in Montaginites. Spores broadly cymbiform, 5 mc. long. Smell disagreeable but not strong. In the northern State the pileus is areolate. On rich garden soil. (Berk., Ann and Mag. Nat. Hist. Vol. 4, 3rd ser., p. 288.)

Volvaria viscosa. Pileus fleshy, campanulate-convex, smooth, very viscous, fulvous-ochraceous; stipe prominently bulbous, nearly equal above, solid, smooth, ochreaceous; volva ample, lobed, concolorous; lamellae touching, brown; spores ovoid-ellipsoid, dilutely fleshy colored, with a large nucleus, 8-5 mc. Pileus 6 cm. wide; stipe 6 cm. long, at base 1½ cm. wide, above ½ cm. (Clements Botanical Survey of Nebraska, No. 2.)

Volvaria speciosa. (Stevenson p. 185. Fries Epic., p. 183.)

Volvaria gloiocephala. (Stevenson, p. 185. Fries Epic., p. 183.)

APPENDIX II.

CORRECTION.

Under Chitonia it was stated in first part of this work that no species had been recorded from the United States. We have since learned that Clements has described a new species under the generic name Clarkeinda, and it was overlooked from that fact. I do not approve at all of the application of the Rochester rules to cryptogams. It would result in an endless confusion in regard to nomenclature and retard the study fifty years. The Lord knows we have enough troubles to contend with now without adding new and needless ones.

Chitonia plana. Pileus carnose, applanate, exactly plane, even, glabrous, ochraceous, or slightly fulvous; stipe short, stout, solid, attenuate above, fibrillose-squamulose, becoming fulvous; volva ample, adpressed, membranaceous; lamellae free, ventricose, crowded, black-cinnamon-colored; spores short ellipsoid, or globose, uniguttate, purple-fulvous, 4-6x6-6 mc. Pileus 7 cm. wide; stipe 3 cm. high, 2 cm. thick. On manured ground. Described by Clements in recent number of Bot. Serv. of Neb., IV., p. 23.

APPENDIX III.

The natural tribes of the old genus Agaricus.

We would arrange the various genera which formerly were included in the Friesian genus Agaricus under the following tribes. There is nothing new in this arrangement as it was proposed by W. G. Smith nearly thirty years ago, but no author has adopted it. It is admitted that the usual system where the genera are arranged primarily by the color of the spores is purely artificial, corresponding to the Linnaean system in the flowering plants. The following arrangement is in keeping with the natural affinities of the genera, and it seems to us would greatly facilitate the study. A beginner meeting an Omphalia would be impressed with the characters of all the Tribe Umbilicae, and as a matter of fact will soon learn to ascribe to the proper tribe, on sight, any specimen he may meet. It only remains to determine the color of the spores (which after a little experience he will guess correctly almost every time from the color of the gills) to know the genus.

Most of the terms used in the tables are self-explanatory, but the distinction between the fleshy and cartilaginous stem is very apt to puzzle one at first. A cartilaginous stem is usually like a tube with a *smooth, even* often polished surface and tough. A fleshy stem is more brittle, and the surface is dull and under a glass seems as if made of fibers. We learn to recognize these stems by experience but it is hard to describe them.

The term "Pileus distinct from the stem" is explained in Note o, page 1 of the Volvæ. In order to determine whether the margin of the pileus is at first straight or involute, *very young* specimens must be examined. It is important to always note this point in a plant of Series 3. Some plants with the general appearance of Collybias are placed in Mycena, because the margins of the young pilei are straight.

Series 1.

Pileus distinct from the fleshy stem.

Plant furnished with a volva. Tribe 1. ***Volvae.***

Plant without volva, ring present. Tribe 2. ***Annulae.***

Plant with neither volva or ring. Tribe 3. ***Exannulae.***

Series 2.

Pileus confluent and homogenous with the fleshy stem.

Plant with a ring. Stipe central. Tribe 4. ***Armillae.***

Plant without a ring. Gills attached with a sinuate tooth. Stipe central. Tribe 5. ***Dentae.***

Plant without ring. Gills decurrent. Stipe central. Tribe 6. ***Clivae.***

Stipe excentric or pileus laterally attached. Tribe 7. ***Excentrae.***

Series 3.

Stipe cartilaginous.

Gills not decurrent. Pileus explanate, margin at first involute. Tribe 8. ***Explanae.***

Gills not decurrent. Pileus campanulate, margin at first straight. Tribe 9. ***Campanulae.***

Gills decurrent. Pileus umbilicate. Tribe 10. ***Umbilicae.***

	Spores White.	Pink.	Ferruginous, Light Brown, Sepia Brown.	Purple or Vandyke Brown.	Black.
Series 1.					
Tribe 1, Volvae,	Amanita,	Volvaria,	Locellina,	Chitonia,	....
Tribe 2, Annulae,	Lepiota,	Annularia,	.....	Psalliota,	.....
Tribe 3, Exannulae,	Schulzeria,	Pluteus,	Pluteolus, ‡	Pilosace,	.....
Series 2.					
Tribe 4, Armillae,	Armillaria,	.....	Pholiota,	Stropharia,	Anellaria,
Tribe 5, Dentae,	Tricholoma,	Entoloma,	Hebeloma,*	Hypholoma,	Panaeolus,
Tribe 6, Clivae,	Cliotocybe,	Clitopilus,	Flammula,	.....	.....
Tribe 7, Excentrae,	Pleurotus,	Claudopus,	Crepidotus,	.....	....
Series 3.					
Tribe 8, Explanae,	Collybia,	Leptonia,	Naucoria,	Psilocybe,	.....
Tribe 9, Campanulae,	Mycena,	Nolanea,	Galera,	Psathyra,	Psathyrella,
Tribe 10, Umbilicae,	Omphalia,	Eccilia,	Tubaria,	Deconia,	....

‡Stipe subcartilaginous but otherwise closely related to Pluteus.
*Including Inocybe.

SYNONYMS.

The following names, considered now synonyms have been used in descriptions of American species. The name of the author given is not the authority for the name but the author who used it.

Amanita	affinis, Frost,	equals Amanita	Frostiana.
"	aurantica, Schw.,	" "	Caesarea.
"	badia,† Peck,	" "	vaginata.
"	bulbosa, Schw.,	" "	phalloides.
"	bulbosa, Rav.,	" "	Ravenelii.
"	Ceciliae, Peck.	" "	strangulata.
"	citrina,* Schw.,	" "	phalloides.
"	formosa,† Peck.,	" "	muscaria.
"	incarnata, Schw.,	" Volvaria	bombycina.
"	livida, Schw.,	" Amanita	vaginata.
"	muscaria var. minor, Peck,	" "	Frostiana.
"	muscaria var. major, Peck,	" "	solitaria.
"	onusta, Howe,	" "	?
"	pellucidula, Banning,	" "	Caesarea.
"	polypyramis, B. & C.,	" "	solitaria.
"	pusilla, Schw.,	" Volvaria	parvula.
"	soleata, Howe,	" Amanita	volvata.
"	spadicea, Schw.,	" "	vaginata.
"	umbrina, Schw.,	" "	pantherina.
"	virescens, Schw.,	" "	phalloides.
"	virgata, Schw.,	" Volvaria	volvacea.
"	viridis, Schw.,	" Amanita	phalloides.
Volvaria	pusilla, Schw.,	" Volvaria	parvula.

*In reality this name was first used by Schaeffer, is now considered in Europe a synonym for mappa.

†Name used only as a synonym.

INDEX.

Names in ITALICS are synonyms.

AMANITA.

VOLVARIA.

INDEX

AUTHOR INDEX

Volume 23, 1960

SUBJECT INDEX

Dates of Publication

Volume 23, 1960

Number 1, March ..... December 16, 1960
Number 2, June ..... February 10, 1961
Number 3, September ..... March 8, 1961
Number 4, December ..... April 10, 1961